



2002 Annual Summary of Water Quality Observations in Streams and Rivers of Chesterfield County



Office of Water Quality

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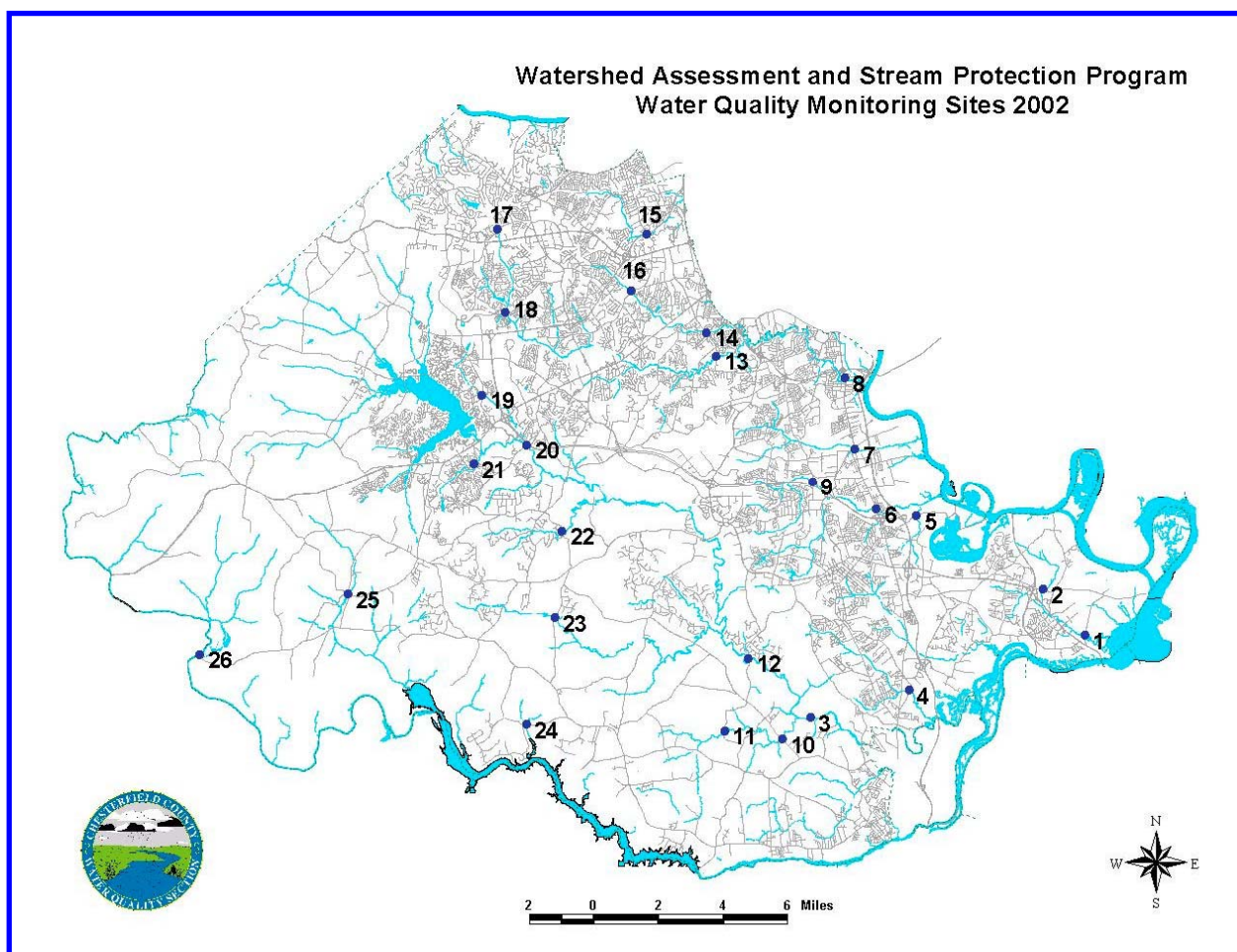
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Introduction:

This report presents the physical and chemical water quality data collected by Chesterfield County's Water Quality Section for the period of January through December of 2002. As a component of Chesterfield County's Watershed Assessment and Stream Protection Program (WASP), twenty-six stream sites were investigated monthly to ascertain the general state of water quality throughout the County and to identify streams that may be in need of special protection and/or remediation. Additionally, this initial data will serve as a baseline for future water quality trending throughout the County.

Sites were selected by a careful review of maps produced from the County's Geographic Information System. Streams were selected to represent a variety of sizes and watershed land uses. Additionally, ease of access was an important component of the sites that were chosen. Following the map analysis, a field survey was conducted in order to verify site locations, accessibility and feasibility. A list of stream sites was finalized and assigned a specific reference identifier consisting of the prefix "WQ" (*i.e.* water quality) followed by a sequentially increasing number (01 – 26) to differentiate them from other WASP program sites. Twelve of the 26 final sites overlapped with WASP Biomonitoring sites.



Methods:

Stream sites were sampled monthly during baseflow conditions. Physical parameters were measured *in situ* by use of a Hydrolab[®] Minisonde 4a water quality multiprobe in conjunction with Surveyor 4a data logger system. The Hydrolab[®] Minisonde multiprobe was calibrated using commercially prepared buffer solutions prior to deployment to the field. Parameters measured in the field included temperature, pH, dissolved oxygen, conductivity and total dissolved solids. A semi-quantitative measure of flow was also obtained by recording the time it took for a float to travel a distance of one meter.

Water quality samples were collected in 237 ml low-density polyethylene containers. Samples were obtained from the bank of each site just below the surface of the water by hand or by a long handled sampling pole and immediately placed in a cooler on ice for transfer to the water quality laboratory. Upon returning to the laboratory, sample information was recorded in a sample tracking logbook and assigned a unique number. Samples were then stored at $\leq 4^{\circ}\text{C}$ in the laboratory refrigerator until time of analysis. Care was taken to adhere to analytical holding times for specific analytes.

In the laboratory, a YSI 9100 series photometer was used to analyze samples for five parameters. Samples were analyzed for total alkalinity, calcium hardness, ammonia nitrogen, nitrate nitrogen and phosphate phosphorus. Palintest[®] environmental testing company methods specific to the photometer were used and generally reflected those outlined in *Standard Methods*.

Quality Assurance and Quality Control:

For each parameter analyzed in the laboratory, Method Detection Limits (MDLs) were calculated following the procedure outlined in Section 1030E of *Standard Methods*. Laboratory reporting limits were then determined from these MDLs. On the day of analysis, instrument calibration was verified using a set of photometer primary standards obtained from Palintest[®]. To insure analytical precision and accuracy, a pair of known quality control samples for ammonia nitrogen, nitrate nitrogen and phosphate phosphorus were analyzed. Values obtained were compared to the manufacturer's acceptable recovery limits and charted for record. Out of tolerance values were noted and evaluated for potential causes of error. Due to lack of availability, known concentrations for alkalinity and calcium hardness were not analyzed.

Sample replicates were analyzed every ten samples for each parameter and relative percent differences were calculated. Analytical blanks were used in order to detect any potential contamination that may have occurred during sampling or sample preparation. Manufacturer's recommendations for preventive maintenance were followed for all instruments.

A summary of the tests, methods and reporting limits as well as applicable water quality standards for the analyses is outlined in table 1.

Table 1. Parameters and Analytical Methods.

Parameter	Analytical Method	Reporting Limit	Water Quality Standard	Reference
Dissolved Oxygen	Probe: Hydrolab [®] Minisonde	0.20 mg/L*	≥ 4.0 mg/L	VADEQ
pH	Probe: Hydrolab [®] Minisonde	0.20 units*	6.0 – 9.0 units	VADEQ
Conductivity	Probe: Hydrolab [®] Minisonde	1.0 µS/cm*	≤ 500 µS/cm	None
Total Dissolved Solids	Probe: Hydrolab [®] Minisonde	0.10 mg/L*	≤ 500 mg/L	PA State Standard
Temperature	Probe: Hydrolab [®] Minisonde	0.10 °C*	≤ 32 °C	VADEQ
Alkalinity	Palintest [®] : Alkaphot	10 mg/L	≥ 20 mg/L	DE, KY, & PA State Standard
Calcium Hardness	Palintest [®] : Calcicol	10 mg/L	≤ 85 = “soft”	None
Ammonia Nitrogen	Palintest [®] : Phenate	0.03 mg/L	0.04 mg/L Forested Area	Schueler, 1997b
Nitrate Nitrogen	Palintest [®] : Nitratest	0.02 mg/L	0.095 mg/L	EPA, 2000
Phosphate Phosphorus	Palintest [®] : Phosphate LR	0.01 mg/L	0.01 mg/L Forested Area	Caraco, 2001
Flow	USGS: Float	0.01 m/s	None	None

*When a method detection limit was not applicable for a parameter, it was replaced by an estimation of accuracy based on manufacturer's specifications.

Comparative Index of Chemical Water Quality:

An index of water quality was developed to describe relative chemical water quality among the sites monitored during 2002. Monthly water quality measurements were entered into an EXCEL spreadsheet and quality scores were assigned based upon values obtained by a literature and web based search of current Virginia, Mid-Atlantic States and Regional EPA water quality standards. The measurement scores were summed and compared to an ideal score (*i.e.* the score if all measurements met the standards). Cumulative percentile plot analysis resulted in a set of four criteria based upon the 10th, 50th and 90th percentile which were categorically identified as “poor”, “fair”, “good” and “excellent”. Annual median scores were calculated and used to characterize the overall chemical water quality for each site. It should be noted that the index describes only the chemistry of the water for identified parameters and should not be interpreted as a full measure of aquatic health.

Site Descriptions and Summaries:

The following pages describe each site and contain a summary of the observations made during the course of the year. All photos depict upstream views unless otherwise noted. Left and right banks are referenced from the perspective looking upstream.

Site Number WQ-01

Stream: Johnson Creek

Site: Approximately 10 meters
Upstream of Allied Road; Bermuda
Hundred, Virginia

Latitude: 37° 19' 23.84583"

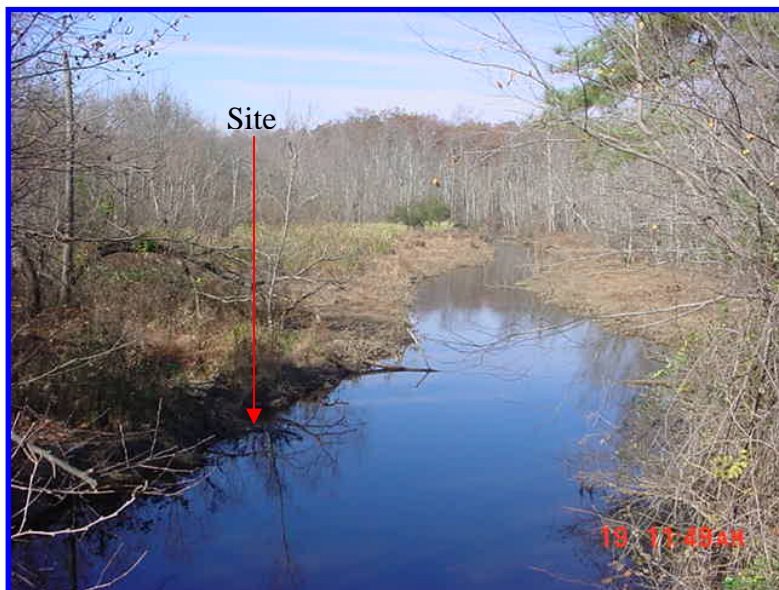
Longitude: 77° 18' 24.18173"

Watershed: Appomattox River

Stream Order: 3

Landuse: Mixed Forested and
Commercial/Industrial Properties

Gradient: Low/Tidally Influenced

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	10.3	5.3	187	119.2	4.6	15	30	0.03	0.07	0.11	0.00	76.9
02/11/02	9.4	5.7	140	89.7	7.4	25	20	<0.03	0.05	0.16	0.00	84.6
03/06/02	9.2	5.9	222	142.0	5.4	95	<10	0.04	0.02	0.05	0.00	84.6
04/22/02	8.4	6.0	93	59.6	16.2	25	<10	0.08	0.08	0.04	0.04	84.6
05/14/02	1.6	6.5	101	64.4	19.1	65	10	0.11	0.06	0.05	0.00	76.9
06/24/02	0.4	6.4	305	194.8	26.7	80	25	<0.03	<0.02	0.06	0.00	84.6
07/15/02	4.8	6.0	299	191.0	24.0	60	30	<0.03	0.08	0.06	0.05	92.3
08/19/02	4.2	6.2	570	365.4	27.8	130	60	<0.03	0.05	0.11	0.00	84.6
09/17/02	0.5	6.1	122	78.3	23.0	30	<10	<0.03	0.14	0.02	0.04	76.9
10/14/02	3.4	6.4	696	446.4	19.0	70	40	0.04	0.10	0.02	0.03	76.9
11/19/02	9.7	5.5	75	47.8	8.5	40	<10	<0.03	0.19	0.01	0.08	84.6
12/09/02	11.7	5.8	198	126.5	4.1	15	15	<0.03	0.09	<0.01	0.00	84.6
Minimum	0.4	5.3	75	47.8	4.1	15	<10	<0.03	<0.02	<0.01	0.00	76.9
Median	6.6	6.0	192	122.9	17.6	50	18	<0.03	0.08	0.05	0.00	84.6
Maximum	11.7	6.5	696	446.4	27.8	130	60	0.11	0.19	0.16	0.08	92.3

Johnson Creek is a perennial tributary of the Appomattox River located in the Low River Terrace and Alluvium region of Chesterfield County. It possesses a silt/clay substrate, is slow moving and is tidally influenced. The water is rarely clear and, for the most part, is stained brown or is turbid due to heavy amounts of instream detritus. The stream's banks are not eroded and are well vegetated.

Dominant riparian vegetation includes various species of hardwood trees (notably red maple), shrubs and grasses/herbaceous plants. A large quantity of submergent and emergent vegetation including periphyton, algae cattail and arrow arum was noted throughout the year.

Samples were obtained from the left bank at a median depth of 0.10 meters. Chemically, the water quality was good with some loss of quality in the early summer and early autumn due to depressed dissolved oxygen levels (<4.0 mg/L). Low pH (<6.0 units) values were noted during the cooler parts of the year and may reflect influences from autumn leaf introduction to the stream. Elevated conductivity and total dissolved solids observed at various times throughout the year may be attributed to the infusion of brackish waters from the tide as well as the severe drought that occurred in 2002. The water of Johnson Creek was soft (Calcium Hardness < 85 mg/L CaCO₃) and generally well buffered (Alkalinity > 20 mg/L CaCO₃). There were no substantially elevated annual median concentrations of ammonia and nitrate nitrogen or phosphate phosphorus for the year.

Site Number WQ-02

Stream: Tributary to Johnson Creek

Site: Off Bridge, Immediately Upstream of Old Bermuda Hundred Road; Bermuda Hundred, Virginia

Latitude: 37° 20' 38.06205"

Longitude: 77° 19' 46.82860"

Watershed: Appomattox River

Stream Order: 2

Landuse: Mixed Forested and Low Density Residential
Sewage Pump Station Upstream and Adjacent to Creek

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	8.2	5.2	214	136.1	4.6	30	30	<0.03	0.15	0.06	0.00	76.9
02/11/02	8.8	5.6	159	104.0	7.5	15	20	<0.03	0.08	0.06	0.00	76.9
03/06/02	9.2	5.6	140	89.4	4.7	30	10	<0.03	0.10	0.09	0.00	84.6
04/22/02	6.8	5.3	71	45.3	15.8	25	<10	<0.03	0.03	0.01	0.16	92.3
05/14/02	6.9	5.9	75	47.7	17.6	55	<10	<0.03	0.04	0.01	0.00	92.3
06/24/02	1.1	5.8	101	64.6	22.2	60	<10	0.13	0.05	0.25	0.00	61.5
07/15/02	4.8	6.0	87	55.4	21.5	55	<10	0.03	0.07	0.04	0.00	92.3
08/19/02	1.1	5.6	78	50.3	24.7	50	<10	0.22	0.02	0.02	0.00	61.5
09/17/02	5.0	5.0	50	31.8	21.8	30	<10	<0.03	0.42	0.02	0.08	76.9
10/14/02	4.0	5.1	70	44.7	17.1	25	<10	<0.03	0.13	<0.01	0.00	84.6
11/19/02	7.9	4.5	57	36.6	7.1	30	<10	<0.03	0.27	0.02	0.12	76.9
12/09/02	9.2	4.8	189	120.3	3.0	<10	15	<0.03	0.06	<0.01	0.00	84.6
Minimum	1.1	4.5	50	31.8	3.0	<10	<10	<0.03	0.02	<0.01	0.00	61.5
Median	6.8	5.5	83	52.9	16.4	30	<10	<0.03	0.08	0.02	0.00	80.8
Maximum	9.2	6.0	214	136.1	24.7	60	30	0.22	0.42	0.25	0.16	92.3

Tributary to Johnson Creek is a perennial tributary of the Appomattox River located in the Deep Coastal Plain region of Chesterfield County. It possesses a substrate comprised of silt and clay with small quantities of sand. The stream is very slow moving, almost to the point of being a backwater. Like Johnson's Creek, the water is rarely clear and, for the most part, is stained brown or is turbid due to heavy amounts of instream detritus. The stream's banks are not eroded and are well vegetated.

Dominant riparian vegetation includes various species of hardwood trees, shrubs and grasses. Submergent and emergent vegetation, periphyton and algae were noted throughout the year. Frogs and brown water snakes were also observed on occasion, especially during the warmer parts of the year.

Samples were obtained mid-channel from the culvert crossing at a median depth of 0.10 meters. The annual median index score indicated fair chemical water quality. There was some loss of quality in the summer due to depressed dissolved oxygen levels. Low pH values were noted throughout the year and may reflect the natural condition for this stream. Conductivity measurements and total dissolved solids concentration were within normal expected ranges. The stream's water was soft and generally well buffered. There were no elevated annual median concentrations of nutrients as measured by ammonia and nitrate nitrogen or phosphate phosphorus.

Site Number WQ-03

Stream: Swift Creek

Site: Off Bank, At End of John Winston
Jones Parkway, Behind Matoaca High
School, Matoaca, Virginia

Latitude: 37° 17' 15.99025"

Longitude: 77° 27' 37.66647"

Watershed: Swift Creek

Stream Order: 4

Landuse: Forested and Low Density
Residential; School ≈ 1000m Upstream
of Site

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	13.1	5.2	89	57.1	3.3	30	<10	<0.03	0.06	0.11	0.46	84.6
02/11/02	11.2	6.7	100	63.6	6.8	10	20	<0.03	0.25	0.09	0.15	76.9
03/06/02	10.9	6.4	94	59.9	4.5	20	20	<0.03	0.03	0.06	0.06	92.3
04/22/02	7.7	6.7	88	56.5	18.0	25	15	0.03	0.13	<0.01	0.31	92.3
05/14/02	6.8	6.8	110	70.3	19.7	30	20	<0.03	0.22	<0.01	0.06	92.3
06/24/02	3.4	6.3	127	81.0	25.3	50	25	<0.03	0.02	<0.01	0.00	92.3
07/15/02	2.8	6.3	126	81.2	24.0	45	10	<0.03	0.04	0.01	0.00	92.3
08/19/02	5.3	6.3	136	86.8	26.9	40	20	<0.03	0.02	0.01	Low	100.0
09/17/02	5.7	6.2	75	47.9	21.5	30	10	0.03	0.13	0.04	0.03	84.6
10/14/02	4.5	6.4	103	66.3	17.6	30	15	<0.03	0.15	<0.01	0.05	92.3
11/19/02	10.9	6.1	88	55.9	8.4	30	10	<0.03	0.09	0.03	0.20	92.3
12/09/02	13.0	6.2	97	61.8	2.2	25	15	<0.03	0.14	<0.01	0.13	92.3
Minimum	2.8	5.2	75	47.9	2.2	10	<10	<0.03	0.02	<0.01	0.00	76.9
Median	7.2	6.3	98	62.7	17.8	30	15	<0.03	0.11	0.01	0.06	92.3
Maximum	13.1	6.8	136	86.8	26.9	50	25	0.03	0.25	0.11	0.46	100.0

Swift Creek is a perennial tributary of the Appomattox River that bisects the Piedmont and Alluvium region of Chesterfield County and represents one of the major watersheds of the county. It possesses a substrate comprised of sand, gravel and cobble with a number of small boulders present. The creek is, for the most part, sluggish, but exhibits high flows periodically through the year. Observations of the clarity of the water indicated an even mix of clear and stained water conditions throughout the year. The stream's banks exhibit a moderate degree of erosion and are not well vegetated. A new county high school was constructed immediately upstream of the site during 2002.

Dominant riparian vegetation includes various species of hardwood trees and shrubs. Periphyton, algae and bacterial sheens were noted throughout the year.

Samples were obtained from the left bank at a median depth of 0.10 meters. The annual median index score reflected excellent chemical water quality. Dissolved oxygen levels were low in the summer but did not appear to substantially impact the overall water quality. pH, conductivity and total dissolved solids concentration were all within normal expected ranges. The stream's water was soft and generally well buffered. There were no elevated annual median concentrations of nutrients as measured by ammonia and nitrate nitrogen or phosphate phosphorus during 2002.

Site Number WQ-04

Stream: Timsberry Creek

Site: Approximately 10 meters Upstream
of Crossing of Happy Hill Road, Colonial
Heights, Virginia

Latitude: 37° 17' 58.66529"

Longitude: 77° 24' 18.20753"

Watershed: Lower Swift Creek

Stream Order: 3

Landuse: Low Density Residential

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	12.0	6.0	134	85.7	4.4	20	20	<0.03	0.07	0.12	0.08	92.3
02/11/02	11.6	6.1	104	66.3	7.4	<10	20	<0.03	0.15	0.10	0.29	76.9
03/06/02	12.1	6.0	100	63.8	4.6	30	15	<0.03	0.04	0.22	0.14	84.6
04/22/02	10.8	5.9	76	48.0	15.4	30	<10	0.11	0.13	0.09	0.63	69.2
05/14/02	8.4	6.3	80	51.1	17.5	85	<10	0.07	0.18	0.04	0.29	76.9
06/24/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
07/15/02	6.4	5.8	101	64.9	22.4	95	<10	0.13	0.10	0.10	0.33	76.9
08/19/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/17/02	6.9	5.7	84	53.6	21.6	50	<10	0.06	0.09	0.05	0.92	76.9
10/14/02	7.6	6.0	101	64.3	17.0	30	<10	<0.03	0.11	0.03	0.14	84.6
11/19/02	11.3	5.4	85	54.6	8.2	25	10	0.03	0.11	0.04	0.51	76.9
12/09/02	13.1	5.6	102	65.4	3.4	<10	10	<0.03	0.15	<0.01	0.35	76.9
Minimum	6.4	5.4	76	48.0	3.4	<10	<10	<0.03	0.04	<0.01	0.08	0.0
Median	11.0	5.9	100	64.1	11.8	30	<10	<0.03	0.11	0.07	0.31	76.9
Maximum	13.1	6.3	134	85.7	22.4	95	20	0.13	0.18	0.22	0.92	92.3

Timsberry Creek is a perennial tributary of Swift Creek located in the Deep Coastal Plain region of Chesterfield County. Its substrate is comprised of sand and gravel. During 2002, Timsberry Creek exhibited a wide range of flow conditions from being completely dry during June and August to flows of almost one meter per second in September. Observations of the clarity of the water indicated a dominance of clear condition. Milky water was noted after dry conditions, perhaps related to the resuspension of sediment following resumption of flow. The stream's banks exhibit slight erosion and are well vegetated.

Dominant riparian vegetation includes various species of hardwood trees and shrubs with seasonal appearances of grasses and herbaceous growth. Periphyton, algae, macroinvertebrates and amphibians were noted during cooler months.

Samples were obtained from the left bank at a median depth of 0.10 meters. The annual median index score reflected fair chemical water quality, most likely influenced by the dry conditions brought on by the summer drought. Physical parameters were within normal expected ranges during 2002. The stream's water was extremely soft and generally well buffered. There were no elevated concentrations of ammonia or nitrate nitrogen during the year. The annual median phosphate phosphorus value (0.07 mg/L P) was greater than expected (0.01 mg/L P). Timsberry Creek flows through denser residential areas at its headwaters, which may contribute to this increase of phosphorus.

Site Number WQ-05

Stream: Redwater Creek

Site: Approximately 20 meters Upstream of Crossing of Coxendale Road, Chester, Virginia

Latitude: 37° 22' 38.73022"

Longitude: 77° 23' 59.62777"

Watershed: James River

Stream Order: 2

Landuse: Industrial with Scattered Forests; Railroad tracks run parallel to western bank of the stream and cross the creek upstream of the monitoring site; Sanitary sewer line runs parallel to east bank

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	11.8	6.3	157	99.5	6.1	25	25	0.06	0.24	0.08	0.27	76.9
02/11/02	10.7	6.3	131	83.2	9.2	15	15	<0.03	0.18	0.07	0.30	76.9
03/06/02	11.4	6.0	147	93.6	7.1	15	10	<0.03	0.13	0.29	0.13	69.2
04/22/02	8.5	6.1	104	66.5	17.2	40	<10	0.12	0.14	0.03	0.45	76.9
05/14/02	7.8	6.3	109	69.3	18.5	65	<10	0.11	0.15	0.02	0.29	76.9
06/24/02	6.2	6.0	142	90.9	24.3	40	<10	0.13	0.15	0.01	0.21	84.6
07/15/02	6.9	5.9	164	104.9	23.0	40	<10	0.10	0.08	0.01	0.18	84.6
08/19/02	5.7	5.8	140	89.6	25.5	55	10	0.21	0.09	0.01	0.08	76.9
09/17/02	7.1	5.7	72	45.7	22.8	55	<10	0.05	0.07	0.03	0.25	76.9
10/14/02	6.6	6.0	114	72.7	17.1	35	<10	0.06	0.08	<0.01	0.15	92.3
11/19/02	8.4	5.6	97	62.1	8.6	40	<10	0.05	0.07	0.04	0.06	76.9
12/09/02	11.8	5.7	301	192.6	3.5	15	15	0.04	0.18	<0.01	0.23	76.9
Minimum	5.7	5.6	72	45.7	3.5	15	<10	<0.03	0.07	<0.01	0.06	69.2
Median	8.1	6.0	135	86.4	17.2	40	<10	0.06	0.14	0.02	0.22	76.9
Maximum	11.8	6.3	301	192.6	25.5	65	25	0.21	0.24	0.29	0.45	92.3

Redwater Creek is a perennial tributary of the James River located in the Deep Coastal Plain region of Chesterfield County. Its substrate is comprised largely of sand, with gravel and cobble present downstream of the monitoring site. Redwater Creek exhibited good flows throughout the year despite the drought, with clear water observed seven out of twelve surveys. When the water in Redwater Creek was not clear, it was predominately turbid indicating a high degree of fine sediment suspension. The banks of Redwater Creek are moderately eroded which more than likely contribute to the turbid waters observed at times.

Dominant riparian vegetation was comprised of a variety of herbaceous plants, grasses and shrubs. Hardwood trees and shrubs were present upstream of the monitoring site. Bacterial Sheens, periphyton, algae, macroinvertebrates and amphibians were noted during the year. Several White-tail Deer carcasses were disposed of immediately adjacent to the monitoring site during hunting season.

Samples were obtained from the left bank at a median depth of 0.10 meters. The annual median index score reflected fair chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. The stream's water was extremely soft and generally well buffered. Annual median nitrogen levels as measured by ammonia (0.06 mg/L N) and nitrate (0.14 mg/L N) were slightly elevated as were annual median phosphate phosphorus concentrations. The industrial nature of the watershed may have contributed to the increased concentrations of nutrients observed in 2002.

Site Number WQ-06

Stream: Proctors Creek

Site: Immediately Upstream of Bridge
Crossing of Jefferson Davis Highway,
Chester, Virginia

Latitude: 37° 22' 50.66538"

Longitude: 77° 25' 20.23005"

Watershed: James River

Stream Order: 3

Landuse: Mixed Commercial with
Forests; Automobile Dealership on South
Bank of Site

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	11.9	6.3	104	66.6	5.8	25	15	<0.03	0.14	0.08	0.13	84.6
02/11/02	11.7	6.1	98	63.1	8.8	15	<10	<0.03	0.14	0.07	0.16	76.9
03/06/02	11.5	6.0	84	53.8	7.1	25	10	<0.03	0.03	0.02	0.12	92.3
04/22/02	8.2	5.9	75	48.1	16.7	40	<10	0.06	0.05	0.02	0.40	76.9
05/14/02	4.1	6.3	88	56.9	19.2	55	<10	0.05	0.10	0.05	0.10	84.6
06/24/02	6.2	6.3	110	70.5	22.4	30	10	<0.03	0.19	0.07	0.00	84.6
07/15/02	4.3	6.0	243	155.5	21.8	40	15	<0.03	0.13	0.08	0.00	84.6
08/19/02	1.6	5.9	163	104.3	25.5	65	15	<0.03	0.03	0.25	0.00	69.2
09/17/02	6.1	5.6	81	52.3	22.3	30	<10	<0.03	0.06	0.14	0.13	84.6
10/14/02	3.9	5.8	95	60.5	17.8	30	<10	<0.03	0.03	<0.01	0.08	84.6
11/19/02	11.0	5.4	80	50.8	8.9	15	<10	<0.03	0.07	0.01	0.17	84.6
12/09/02	13.0	5.6	127	81.2	3.2	10	15	<0.03	0.10	<0.01	0.16	84.6
Minimum	1.6	5.4	75	48.1	3.2	10	<10	<0.03	0.03	<0.01	0.00	69.2
Median	7.2	5.9	96	61.8	17.2	30	<10	<0.03	0.09	0.06	0.13	84.6
Maximum	13.0	6.3	243	155.5	25.5	65	15	0.06	0.19	0.25	0.40	92.3

Proctors Creek is a perennial tributary of the James River located in the Deep Coastal Plain region of Chesterfield County. Its substrate is comprised largely of fine particles (sand and silt), with gravel and cobble present in the form of riprap. Proctors Creek is a slow moving stream which went into a no flow state during the summer months. The waters of Proctors Creek usually are stained brown or are turbid during warmer months and are clearer in the winter. The banks of Proctors Creek are well vegetated with slight erosion present. A large amount of trash is present downstream of the monitoring site along the Jefferson Davis Highway Bridge.

Dominant riparian vegetation was comprised primarily of trees, shrubs and grasses. Bacterial Sheens, iron bacteria, periphyton, algae and a variety of submerged and emergent plants were observed during the year.

Samples were obtained from the right bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. The stream's water was extremely soft and generally well buffered. There were no elevated concentrations of ammonia or nitrate nitrogen during the year; however, the annual median phosphate phosphorus value (0.09 mg/L P) was greater than expected. The high phosphate phosphorus values noted during August and September contributed to this observation and may be due in part to the low flow and subsequent resumption of flow.

Site Number WQ-07

Stream: Kingsland Creek

Site: 25 meters Upstream of Bridge
Crossing of Jefferson Davis Highway,
Bellwood, Virginia

Latitude: 37° 24' 27.92933"

Longitude: 77° 26' 02.39536"

Watershed: James River

Stream Order: 3

Landuse: Mixed Commercial and
Residential

Gradient: High

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	12.2	6.1	146	92.8	6.0	15	40	<0.03	0.41	0.09	0.36	76.9
02/11/02	11.6	6.3	132	84.6	8.6	15	15	<0.03	0.33	0.07	0.64	76.9
03/06/02	12.3	6.2	117	75.2	6.7	15	15	<0.03	0.17	0.04	0.29	76.9
04/22/02	9.1	5.9	73	46.9	15.7	45	10	0.05	0.06	0.03	0.64	76.9
05/14/02	9.4	6.3	80	51.2	17.4	45	10	<0.03	0.13	0.01	0.40	92.3
06/24/02	6.9	6.4	232	148.7	24.5	15	45	0.03	0.92	0.13	0.21	69.2
07/15/02	7.3	6.0	127	81.4	23.5	10	20	0.06	0.38	0.06	0.29	69.2
08/19/02	7.2	6.2	267	170.5	27.1	25	60	<0.03	0.80	0.04	0.18	76.9
09/17/02	7.5	6.1	102	65.2	21.9	10	15	<0.03	0.21	0.01	0.40	84.6
10/14/02	7.7	6.3	130	83.0	16.9	15	20	<0.03	0.33	0.01	0.45	84.6
11/19/02	11.7	5.6	91	58.2	9.5	25	<10	<0.03	0.13	0.01	0.43	84.6
12/09/02	13.2	5.9	160	102.4	4.5	15	20	<0.03	0.20	<0.01	0.38	76.9
Minimum	6.9	5.6	73	46.9	4.5	10	<10	<0.03	0.06	<0.01	0.18	69.2
Median	9.2	6.1	128	82.2	16.3	15	18	<0.03	0.27	0.04	0.39	76.9
Maximum	13.2	6.4	267	170.5	27.1	45	60	0.06	0.92	0.13	0.64	92.3

Kingsland Creek is a perennial tributary of the James River located in the Low River Terrace and Alluvium region of Chesterfield County. Its substrate is comprised primarily of gravel and cobble with some finer particles such as sand present. Kingsland Creek is a relatively swift moving stream with clear waters. Stained and turbid waters were only observed in April and May of 2002. The banks of Kingsland Creek are well vegetated with slight erosion present. A large grassy area that is part of a motel complex is present downstream of the monitoring site along the south bank.

Dominant riparian vegetation was comprised primarily of trees, shrubs and grasses. A variety of instream life was observed during the year and included periphyton, algae, emergent plants, macroinvertebrates and fish.

Samples were obtained from the left bank at a median depth of 0.05 meters. The annual median index score indicated fair chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. The stream's water was extremely soft and not well buffered (annual median alkalinity < 20 mg/L CaCO₃). There were no elevated concentrations of ammonia nitrogen however nitrate nitrogen levels were generally high throughout the year. Phosphate phosphorus values were slightly elevated as well. The observations of increased nutrient concentrations are to be expected in a more urban watershed such as Kingsland Creek's.

Site Number WQ-08

Stream: Falling Creek

Site: Immediately Upstream of the Old
Stone Bridge in Falling Creek Wayside
Park, Bellwood, Virginia

Latitude: 37° 26' 23.12287 "

Longitude: 77° 26' 21.08859 "

Watershed: Falling Creek

Stream Order: 3

Landuse: Mixed Commercial and
Residential

Gradient: High

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	11.8	6.9	151	96.2	4.9	40	30	0.05	0.20	0.08	0.35	76.9
02/11/02	9.5	6.6	254	162.5	8.6	25	40	1.08	0.20	0.20	0.32	53.8
03/06/02	10.3	6.5	205	131.0	7.6	25	25	1.34	0.08	0.24	0.18	61.5
04/22/02	9.4	6.9	135	86.1	19.0	15	30	0.09	0.15	0.02	0.76	69.2
05/14/02	8.5	6.9	113	72.4	21.8	30	20	0.06	0.14	<0.01	0.33	84.6
06/24/02	6.2	6.5	126	80.5	25.9	25	25	<0.03	0.32	0.02	0.06	84.6
07/15/02	6.3	6.4	137	87.4	24.3	40	10	0.13	0.13	0.07	0.05	76.9
08/19/02	7.6	6.4	149	95.1	26.8	35	30	<0.03	0.15	0.03	0.04	84.6
09/17/02	7.5	6.4	122	77.8	24.1	15	20	<0.03	0.14	<0.01	0.30	84.6
10/14/02	7.0	6.7	126	80.8	20.2	25	10	<0.03	0.14	0.01	0.20	92.3
11/19/02	11.9	6.3	101	64.7	10.3	35	10	<0.03	0.20	0.03	0.45	84.6
12/09/02	13.4	6.5	124	79.5	4.5	25	25	0.03	0.17	0.02	0.44	84.6
Minimum	6.2	6.3	101	64.7	4.5	15	10	<0.03	0.08	<0.01	0.04	53.8
Median	8.9	6.5	130	83.5	19.6	25	25	0.04	0.15	0.02	0.31	84.6
Maximum	13.4	6.9	254	162.5	26.8	40	40	1.34	0.32	0.24	0.76	92.3

Falling Creek is a perennial tributary of the James River that bisects the northeastern portion of Chesterfield County and represents one of the major watersheds of the county. Site WQ-08 lies within the Low River Terrace and Alluvium region where its substrate is comprised primarily of large particles such as gravel, cobble, boulders and bedrock. At this site, Falling Creek is a relatively swift moving stream. The water's coloration was an even mix of clear and stained/turbid observations throughout the year. The banks of Falling Creek are well vegetated with slight erosion present.

Dominant riparian vegetation was comprised primarily of trees, shrubs with some grasses and herbaceous growth present. A variety of instream life was observed during the year and included periphyton, algae, submergent and emergent plants, macroinvertebrates and fish.

Samples were obtained from the left bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. The stream's water was characterized as extremely soft and generally well buffered. Annual median concentrations of ammonia and nitrate nitrogen levels were slightly elevated and there were two instances of extremely high measurements of ammonia (>1.00 mg/L) during February and March. Phosphate phosphorus values were slightly elevated as well and the greatest concentrations were observed coincidentally with the high nitrate levels. Additional monitoring during 2003 may be able to confirm if this increase is a seasonal occurrence.

Site Number WQ-09

Stream: Proctors Creek

Site: Immediately Downstream of the
Hopkins Road Bridge Crossing,
Chesterfield, Virginia

Latitude: 37° 23' 36.20368 "

Longitude: 77° 27' 28.75051 "

Watershed: James River

Stream Order: 2

Landuse: Wetland

Gradient: Low

**Field and Laboratory Observations:***View is downstream of bridge*

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	5.0	6.0	259	164.9	6.9	20	20	<0.03	0.11	0.07	0.00	84.6
02/11/02	7.7	5.7	95	60.5	7.9	15	10	<0.03	0.06	0.07	0.00	76.9
03/06/02	9.3	5.5	83	52.6	7.0	30	<10	<0.03	0.04	0.02	0.00	84.6
04/22/02	8.5	6.1	66	41.9	20.6	25	<10	0.06	0.16	0.03	0.11	76.9
05/14/02	8.2	6.2	61	39.0	22.5	45	<10	0.03	0.06	0.01	0.07	100.0
06/24/02	4.1	6.0	78	49.9	26.6	35	10	0.04	<0.02	0.01	0.00	100.0
07/15/02	5.3	6.3	203	129.8	26.7	30	<10	<0.03	0.03	<0.01	0.00	100.0
08/19/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/17/02	3.8	5.0	60	38.1	23.4	25	<10	<0.03	0.04	0.05	0.00	76.9
10/14/02	3.3	5.3	81	52.0	18.6	15	10	<0.03	0.04	<0.01	0.00	76.9
11/19/02	9.5	5.5	75	48.3	10.1	15	10	<0.03	0.11	0.04	0.12	69.2
12/09/02	13.5	5.8	117	75.2	4.4	10	20	<0.03	0.13	0.01	0.07	76.9
Minimum	3.3	5.0	60	38.1	4.4	10	<10	<0.03	<0.02	<0.01	0.00	0.0
Median	7.7	5.8	81	52.0	18.6	25	10	<0.03	0.06	0.02	0.00	76.9
Maximum	13.5	6.3	259	164.9	26.7	45	20	0.06	0.16	0.07	0.12	100.0

Proctors Creek is a perennial tributary of the James River located in the Deep Coastal Plain region of Chesterfield County. This site is located upstream of the Proctors Creek site WQ-06 and flows sluggishly through a substantial wetland area. During August 2002, Proctors Creek went dry at this location. Its substrate is comprised primarily of silt and fine particles and the water is heavily stained. Its banks are well vegetated with no erosion present.

Dominant riparian vegetation was comprised primarily of grasses and herbaceous growth with scattered shrubs. Periphyton, algae, submergent and emergent plants, macroinvertebrates and fish were observed at this site during the year.

Samples were obtained from the left bank near the bridge at a median depth of 0.10 meters. The annual median index score indicated fair chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. The annual median pH value was below Virginia's water quality standard (6.0 to 9.0 units) and dissolved oxygen concentrations failed to meet standards on two occasions during 2002. These values are not atypical considering the increased amount of organic matter present in wetland systems. The stream's water was characterized as extremely soft and generally well buffered. Annual median concentrations of ammonia and nitrate nitrogen and phosphate phosphorus were all within expected limits. This observation reflects the nutrient processing characteristics inherent in wetland systems.

Site Number WQ-10

Stream: Franks Branch

Site: Immediately Downstream of the
Woodpecker Road Bridge Crossing,
Matoaca, Virginia

Latitude: 37° 16' 42.61307"

Longitude: 77° 28' 34.84916"

Watershed: Swift Creek

Stream Order: 3

Landuse: Rural Residential with Fields
and Forests; Some recent silvaculture
activity

Gradient: Low

*View is downstream of bridge***Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	12.3	6.1	49	31.5	3.9	25	<10	<0.03	0.04	0.08	0.26	92.3
02/11/02	11.7	6.2	53	34.0	7.2	15	<10	<0.03	<0.02	0.14	0.26	84.6
03/06/02	12.1	6.0	48	31.0	3.9	10	<10	<0.03	0.02	0.06	0.12	84.6
04/24/02	10.0	6.1	51	32.5	14.0	40	<10	<0.03	0.04	0.03	0.37	92.3
05/14/02	7.3	6.4	53	34.1	17.5	30	<10	<0.03	0.13	0.01	0.14	92.3
06/24/02	0.8	5.9	88	56.2	21.4	45	10	0.13	0.03	0.08	0.00	69.2
07/15/02	2.9	5.6	69	44.0	21.8	85	<10	0.27	0.04	0.15	0.00	53.8
08/19/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/17/02	6.8	5.9	62	39.5	20.9	25	<10	<0.03	0.07	0.10	0.15	84.6
10/14/02	6.5	6.0	70	45.1	16.1	20	<10	<0.03	0.03	0.03	0.12	92.3
11/19/02	11.4	5.2	61	39.2	7.9	15	<10	0.03	0.09	0.01	0.40	84.6
12/09/02	13.4	5.3	52	33.3	2.7	10	<10	<0.03	0.11	<0.01	0.33	76.9
Minimum	0.8	5.2	48	31.0	2.7	10	<10	<0.03	<0.02	<0.01	0.00	0.0
Median	10.0	6.0	53	34.1	14.0	25	<10	<0.03	0.04	0.06	0.15	84.6
Maximum	13.4	6.4	88	56.2	21.8	85	10	0.27	0.13	0.15	0.40	92.3

Franks Branch is a perennial tributary of Swift Creek and is located in the Piedmont and Alluvium region of Chesterfield County. Its substrate is comprised primarily of sand and gravel. Franks Branch is a slow moving stream and during August 2002, went dry at this location. During the monthly surveys, clear water was noted five times with the remainder of the observations characterized as stained or turbid. The stream's banks are vegetated with slight to moderate areas of erosion present.

Dominant riparian vegetation was comprised primarily of hardwood trees and shrubs with grasses and herbaceous growth present during the summer months. A variety of instream biota including periphyton, algae, submergent and emergent plants, macroinvertebrates and fish were observed at this site during the year.

Samples were obtained from the right bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. Several summer pH values and dissolved oxygen concentrations failed to meet standards during 2002. The stream's water was extremely soft and generally well buffered. Annual median concentrations of ammonia and nitrate nitrogen levels were within expected limits. Annual median phosphate concentrations were elevated (0.06 mg/L P) and may be attributed to the large fields and remnants of silvaculture present immediately upstream of the site.

Site Number WQ-11

Stream: Franks Branch

Site: Immediately Downstream of the
Rhodes Lane Bridge Crossing, Matoaca,
Virginia

Latitude: 37° 16' 57.12337"

Longitude: 77° 30' 32.50884"

Watershed: Swift Creek

Stream Order: 2

Landuse: Rural Residential with Forests

Gradient: Low

**Field and Laboratory Observations:***View is downstream of bridge*

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	11.7	6.1	43	27.8	4.1	30	15	<0.03	0.03	0.10	0.26	92.3
02/11/02	10.7	6.1	48	30.4	7.1	20	<10	<0.03	<0.02	0.09	0.76	92.3
03/06/02	10.9	5.6	43	27.3	4.7	30	<10	<0.03	0.05	0.07	0.31	84.6
04/22/02	7.7	6.2	48	30.8	16.5	45	<10	<0.03	0.04	0.05	0.57	92.3
05/14/02	6.7	6.2	46	29.3	18.3	40	<10	0.04	0.06	0.03	0.29	92.3
06/24/02	4.3	6.2	65	41.6	22.0	40	<10	0.05	0.09	<0.01	0.20	92.3
07/15/02	1.7	5.4	74	47.1	19.7	30	10	0.17	0.13	0.09	No Flow	53.8
08/19/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/17/02	5.5	5.3	69	44.3	21.0	30	<10	0.03	0.02	0.06	0.53	84.6
10/14/02	5.6	5.6	63	40.3	17.0	25	<10	<0.03	0.06	0.05	0.41	84.6
11/19/02	10.8	4.8	53	33.9	7.5	15	<10	<0.03	0.24	0.01	0.40	76.9
12/09/02	12.8	5.3	43	27.6	2.2	15	10	<0.03	0.03	<0.01	0.47	84.6
Minimum	1.7	4.8	43	27.3	2.2	15	<10	<0.03	<0.02	<0.01	0.20	0.0
Median	7.7	5.6	48	30.8	16.5	30	<10	<0.03	0.05	0.05	0.41	84.6
Maximum	12.8	6.2	74	47.1	22.0	45	15	0.17	0.24	0.10	0.76	92.3

Franks Branch is a perennial tributary of Swift Creek and is located in the Piedmont and Alluvium region of Chesterfield County. This site is located upstream of the Franks Branch site WQ-10 and flows rapidly through a densely forested area. Its substrate is comprised primarily of sand, gravel and cobble. Franks Branch is a swift moving stream and during August 2002, went dry at this location. During the monthly surveys, clear water conditions dominated with stained water noted twice. The stream's banks are well vegetated with slight to moderate areas of erosion present.

Dominant riparian vegetation was comprised primarily of hardwood trees and shrubs with grasses present during the summer months. A variety of instream biota including bacterial sheens, periphyton, algae, submergent and emergent plants, macroinvertebrates and amphibians were observed at this site during the year.

Samples were obtained from the right bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. In July, dissolved oxygen concentrations failed to meet standards, as did pH values during the latter half of 2002. One observation of pH in November was below 5.0 units, reflecting the leaching of tannic and other organic acids from the autumn leaf fall in this forested system. The stream's water was characterized as extremely soft and generally well buffered. Annual median concentrations of ammonia and nitrate nitrogen levels were within expected limits. Annual median phosphate concentrations were slightly elevated (0.05 mg/L P) for a forested site.

Site Number WQ-12

Stream: Swift Creek

Site: Immediately Downstream of the
Bradley Bridge Road Crossing,
Chesterfield, Virginia

Latitude: 37° 18' 52.88240"

Longitude: 77° 29' 42.18561"

Watershed: Swift Creek

Stream Order: 5

Landuse: Low Density Residential with
Forests

Gradient: Low

*View is downstream of bridge***Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	12.8	6.9	93	59.7	3.7	30	25	<0.03	0.04	0.10	0.14	92.3
02/11/02	10.9	6.7	113	72.2	7.2	15	20	<0.03	0.04	0.10	0.08	84.6
03/06/02	11.4	5.8	104	66.5	5.1	30	15	<0.03	0.04	0.04	0.08	84.6
04/24/02	8.8	6.2	82	52.6	14.6	30	10	<0.03	0.10	0.09	n/a	92.3
05/14/02	7.4	6.7	114	72.8	19.5	60	<10	0.05	0.23	0.13	0.23	76.9
06/24/02	5.5	6.7	129	82.8	23.6	40	15	<0.03	0.04	<0.01	Low	100.0
07/15/02	4.8	6.5	156	100.2	22.5	45	20	<0.03	0.06	0.02	Low	92.3
08/19/02	3.1	6.2	167	106.8	24.9	60	25	0.06	0.05	0.01	Low	84.6
09/17/02	6.1	6.4	163	104.4	21.3	65	10	0.05	0.22	0.04	0.25	76.9
10/14/02	6.8	6.7	159	101.8	17.8	40	15	<0.03	0.14	<0.01	0.13	92.3
11/19/02	10.6	6.1	96	61.5	8.6	30	<10	<0.03	0.10	0.05	0.51	92.3
12/09/02	12.9	5.8	97	62.1	2.3	25	15	0.04	0.17	0.02	0.49	76.9
Minimum	3.1	5.8	82	52.6	2.3	15	<10	<0.03	0.04	<0.01	0.08	76.9
Median	8.1	6.5	113	72.5	16.2	35	15	<0.03	0.08	0.04	0.19	88.5
Maximum	12.9	6.9	167	106.8	24.9	65	25	0.06	0.23	0.13	0.51	100.0

Swift Creek is a perennial tributary and major watershed of the Appomattox River that bisects the Piedmont and Alluvium region of Chesterfield County. This site is located approximately 2.5 miles upstream of the Swift Creek site WQ-03 and flows through a moderately forested area. Its substrate is comprised primarily of silt and sand with scattered areas of gravel and cobble. The flows at this site ranged from hydrostatic (low) to 0.51 meters/second. During the monthly surveys, clear water conditions were infrequent (4 observations) with turbid or stained waters dominating. The stream's banks are well vegetated with slight to moderate areas of erosion present.

Dominant riparian vegetation was comprised of hardwood trees and shrubs, with grasses present during the summer months. Iron bacteria, sheens, periphyton, algae, submergent plants, macroinvertebrates and amphibians were observed at this site during the year.

Samples were obtained from the right bank at a median depth of 0.20 meters. The annual median index score indicated good chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002 with only one instance of low dissolved oxygen and two low pH values. The stream's water was extremely soft and generally well buffered. Annual median concentrations of ammonia and nitrate nitrogen levels were within expected limits. The annual median phosphate concentration was slightly elevated (0.04 mg/L P). This observed increase is not atypical for a stream with such a large watershed and multiple contributing sources of phosphorus.

Site Number WQ-13

Stream: Falling Creek

Site: Immediately Downstream of the
Turner Road Bridge Crossing,
Midlothian, Virginia

Latitude: 37° 27' 01.26118"

Longitude: 77° 30' 40.54069"

Watershed: Falling Creek

Stream Order: 3

Landuse: Low Density Residential with
Scattered Forested Areas; Church along
East Bank; Sewage Pump Station
Immediately Upstream

Gradient: Low



View is downstream of bridge

Field and Laboratory Observations:

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	8.9	6.4	204	130.6	4.4	25	35	0.03	0.23	0.10	0.03	84.6
02/11/02	9.4	6.3	188	119.9	7.6	15	25	<0.03	0.09	0.10	0.00	84.6
03/06/02	10.9	6.1	132	84.6	5.2	45	15	<0.03	0.05	0.04	0.02	92.3
04/22/02	5.8	6.7	128	81.9	18.8	35	20	0.08	0.13	0.07	0.17	76.9
05/14/02	6.7	6.6	107	68.2	20.2	40	<10	0.04	0.11	0.03	0.20	84.6
06/24/02	2.8	6.3	146	93.4	20.9	30	25	<0.03	0.14	0.01	0.00	84.6
07/15/02	0.5	6.4	168	106.5	21.4	55	25	0.07	0.15	0.09	Low	69.2
08/19/02	0.4	6.1	173	112.4	23.6	55	20	<0.03	0.06	0.04	0.00	84.6
09/17/02	2.8	6.2	127	81.3	20.7	25	15	<0.03	0.22	0.02	0.00	76.9
10/14/02	4.7	6.3	140	89.9	18.2	15	20	<0.03	0.08	0.01	Low	92.3
11/19/02	10.6	6.0	103	65.7	9.3	30	10	0.04	0.10	0.02	0.16	92.3
12/09/02	12.1	6.3	151	96.9	3.7	25	20	<0.03	0.18	0.01	0.00	92.3
Minimum	0.4	6.0	103	65.7	3.7	15	<10	<0.03	0.05	0.01	0.00	69.2
Median	6.2	6.3	143	91.7	18.5	30	20	<0.03	0.12	0.04	0.01	84.6
Maximum	12.1	6.7	204	130.6	23.6	55	35	0.08	0.23	0.10	0.20	92.3

Falling Creek is a perennial tributary of the James River located largely in the Piedmont and Alluvium region of Chesterfield County and is considered one of its major watersheds. This site is located approximately 4 miles upstream of the Falling Creek site WQ-08 and flows sluggishly through a lightly forested area. Its substrate is comprised of silt and sand. The waters at this site were consistently turbid or stained with one exception of clear water observed in September. The stream's banks are well vegetated with very limited erosion.

Dominant riparian vegetation was comprised primarily of hardwood trees and shrubs with grasses and herbaceous growth present during the summer months. Periphyton and algae dominated the biota observed during 2002, often giving the water a greenish hue. Macroinvertebrates were also observed in the autumn.

Samples were obtained from the left bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. Dissolved oxygen concentrations failed to meet standards during July, August and September. The stream's water was characterized as soft and generally well buffered. The annual median concentration of ammonia nitrogen was within expected limits. Annual median nitrate nitrogen and phosphate phosphorus concentrations were slightly elevated but not exceedingly high.

Site Number WQ-14

Stream: Pocoshock Creek

Site: 10 meters Upstream of the Turner
Road Bridge Crossing, Midlothian,
Virginia

Latitude: 37° 27' 39.25271"

Longitude: 77° 30' 59.88790"

Watershed: Falling Creek

Stream Order: 2

Landuse: Low Density Residential

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/14/02	11.9	6.6	210	134.3	5.2	25	55	<0.03	0.19	0.07	0.08	84.6
02/11/02	10.7	6.8	154	98.6	8.2	30	35	<0.03	0.08	0.07	0.20	92.3
03/06/02	12.3	6.7	137	87.8	7.5	50	20	<0.03	0.04	0.08	0.15	92.3
04/11/02	10.4	6.5	137	87.4	12.7	25	30	<0.03	0.06	0.01	0.17	100.0
05/14/02	9.0	6.6	97	62.1	17.9	50	<10	0.07	0.16	0.06	0.25	76.9
06/24/02	4.7	6.4	125	80.0	23.8	30	15	<0.03	0.15	0.02	0.17	84.6
07/15/02	6.4	6.4	132	84.6	22.1	50	15	0.04	0.23	0.12	0.16	84.6
08/19/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/17/02	6.8	6.3	125	79.6	22.0	30	20	<0.03	0.09	0.08	0.11	92.3
10/14/02	6.8	6.5	113	72.0	17.0	25	15	<0.03	0.07	<0.01	0.11	100.0
11/19/02	11.1	6.1	114	73.1	8.6	25	25	<0.03	0.12	0.02	0.28	84.6
12/09/02	13.0	6.4	351	225.2	3.1	30	40	0.03	0.24	<0.01	0.26	92.3
Minimum	4.7	6.1	97	62.1	3.1	25	<10	<0.03	0.04	<0.01	0.08	0.0
Median	10.4	6.5	132	84.6	12.7	30	20	<0.03	0.12	0.06	0.17	88.5
Maximum	13.0	6.8	351	225.2	23.8	50	55	0.07	0.24	0.12	0.28	100.0

Pocoshock Creek is a perennial tributary of Falling Creek located in the Piedmont and Alluvium region of Chesterfield County. Its substrate is comprised mainly of sand, gravel and cobble. Pocoshock Creek exhibited sustained flows throughout the year and went dry for a brief period in August 2002. The waters at this site were clear on nine of the surveys with the remainder of the observations turbid or stained. The stream's banks are well vegetated with slight to moderate areas of erosion.

Riparian vegetation consisted largely of hardwood trees and shrubs, with grasses present during the early summer months. Periphyton, algae and macroinvertebrates were widely observed at the site during 2002.

Samples were obtained from the left bank at a median depth of 0.05 meters. The annual median index score indicated good chemical water quality. Physical parameters were all within normal expected ranges during 2002. This site on Pocoshock Creek was one of the few areas in which all dissolved oxygen concentrations and pH values met Virginia State Water Quality Standards during all monitoring dates. The stream's water was soft and generally well buffered. The annual median concentration of ammonia nitrogen was within expected limits. Annual median nitrate nitrogen and phosphate phosphorus concentrations were slightly elevated but not exceedingly high.

Site Number WQ-15

Stream: Powhite Creek

Site: 10 meters Downstream of the
Buford Road Bridge Crossing, Bon Air,
Virginia

Latitude: 37° 30' 18.08272"

Longitude: 77° 32' 57.96437"

Watershed: James River

Stream Order: 2

Landuse: Suburban Residential and
Commercial; Route 76 (Powhite
Parkway) runs Parallel to Creek

Gradient: Low

*View is downstream of bridge***Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	11.3	6.7	185	118.7	8.1	30	25	<0.03	0.12	0.11	0.55	84.6
02/11/02	8.9	6.8	158	100.9	9.5	25	30	<0.03	0.05	0.12	0.39	92.3
03/06/02	10.4	6.6	140	89.7	10.5	30	20	<0.03	0.04	0.06	0.46	92.3
04/22/02	7.4	6.6	138	88.4	19.3	45	15	0.16	0.14	0.11	0.40	76.9
05/14/02	7.8	6.6	121	77.1	20.2	45	15	<0.03	0.07	0.04	0.33	92.3
06/25/02	4.3	6.3	189	121.0	26.9	80	35	0.94	0.20	0.09	Low	61.5
07/15/02	5.2	6.1	157	100.6	23.6	45	25	0.37	0.14	0.11	0.18	61.5
08/19/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/17/02	5.5	6.0	136	86.8	23.2	35	20	0.04	0.02	0.03	0.27	92.3
10/14/02	5.7	6.2	122	77.7	17.4	35	10	0.03	0.04	0.01	0.52	100.0
11/19/02	10.3	6.2	130	83.6	9.3	20	20	<0.03	0.26	0.01	0.51	92.3
12/09/02	13.1	6.5	212	135.5	3.4	30	30	<0.03	0.22	0.01	0.60	92.3
Minimum	4.3	6.0	121	77.1	3.4	20	10	<0.03	0.02	0.01	0.18	0.0
Median	7.8	6.5	140	89.7	17.4	35	20	<0.03	0.12	0.06	0.43	92.3
Maximum	13.1	6.8	212	135.5	26.9	80	35	0.94	0.26	0.12	0.60	100.0

Powhite Creek is a perennial tributary of the James River located in the Piedmont region of Chesterfield County. Its substrate is comprised primarily of sand and gravel. Powhite Creek flowed throughout most of the year and went dry for a brief period in August 2002. Aside from the dry period, the waters at this site were clear every month. The stream's banks are well vegetated with only slight areas of erosion present.

Riparian vegetation consisted largely of shrubs and grasses with additional herbaceous growth prevalent from March to November. Macroinvertebrates and fish were observed on occasion however the biota was largely comprised of plants including periphyton, algae and submergent and emergent species.

Samples were obtained from the right bank at a median depth of 0.05 meters. The annual median index score indicated excellent chemical water quality. Physical parameters were all within normal expected ranges during 2002. Powhite Creek was one of the few areas in which all dissolved oxygen concentrations and pH values met Virginia State Water Quality Standards during all monitoring dates. The stream's water was soft and generally well buffered. The annual median concentration of ammonia nitrogen was within expected limits. Annual median nitrate nitrogen and phosphate phosphorus concentrations were slightly elevated but not exceedingly high. The excellent water quality observed here is more than likely due to the buffering effect of an extensive wetland immediately upstream of the site.

Site Number WQ-16

Stream: Pocoshock Creek

Site: At the South Providence Road
Bridge Crossing, Midlothian, Virginia

Latitude: 37° 28' 46.86709"

Longitude: 77° 33' 31.08985"

Watershed: Falling Creek

Stream Order: 2

Landuse: Suburban Residential; Golf
Course

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	11.7	6.5	196	125.6	6.7	50	30	<0.03	0.11	0.12	0.05	84.6
02/11/02	9.2	6.7	171	109.3	9.4	30	20	<0.03	0.05	0.23	0.06	84.6
03/06/02	10.6	6.5	142	90.9	10.4	40	25	<0.03	0.04	0.16	0.00	92.3
04/09/02	6.3	6.6	138	88.2	14.9	45	25	<0.03	0.02	0.14	0.09	92.3
05/14/02	7.8	6.6	112	71.8	20.9	45	10	0.11	0.15	0.06	0.06	76.9
06/25/02	3.2	6.0	143	91.4	24.9	60	25	0.15	0.10	0.09	0.02	76.9
07/15/02	6.5	6.1	199	127.3	25.5	40	30	0.08	0.13	0.11	0.05	76.9
08/19/02	3.2	6.2	114	73.2	25.1	50	15	<0.03	0.02	0.12	0.00	84.6
09/17/02	5.6	5.9	120	77.0	23.5	40	10	0.04	0.06	0.07	0.25	84.6
10/14/02	5.5	6.2	112	71.6	18.0	30	15	<0.03	0.04	0.03	0.25	92.3
11/19/02	8.5	6.1	137	87.4	9.3	30	20	<0.03	0.38	0.01	0.50	92.3
12/09/02	12.1	6.3	387	247.7	3.0	30	40	<0.03	0.14	<0.01	0.25	92.3
Minimum	3.2	5.9	112	71.6	3.0	30	10	<0.03	0.02	<0.01	0.00	76.9
Median	7.1	6.2	140	89.6	16.4	40	23	<0.03	0.08	0.10	0.06	84.6
Maximum	12.1	6.7	387	247.7	25.5	60	40	0.15	0.38	0.23	0.50	92.3

Pocoshock Creek is a perennial tributary of Falling Creek located in the Piedmont and Alluvium region of Chesterfield County. This site is located approximately 2.7 miles upstream of the Pocoshock Creek site WQ-14 and flows sluggishly through a lightly forested area with a golf course. Its substrate is comprised of sand and gravel with cobbles immediately downstream of the bridge crossing. The waters at this site were clear on fifty percent of the occasions visited. The stream's banks are well vegetated with slight amounts of erosion present.

Riparian vegetation consisted largely of trees, shrubs and grasses with additional herbaceous growth present during the early summer. Excessive herbaceous growth forced monitoring efforts from immediately upstream of the bridge crossing to just downstream of the crossing in June. Bacterial sheens, periphyton, algae and emergent plants were observed throughout the year. Macroinvertebrates and fish were also present, more so in the first half of the year.

Samples were obtained from the stream at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were almost all within normal expected ranges during 2002. Dissolved oxygen values were below standards during July and August. The stream's water was characterized as soft and generally well buffered. Annual median concentrations of ammonia and nitrate nitrogen were within expected limits. The annual median phosphate phosphorus concentration was elevated (0.10 mg/L P) and may be attributed to the presence of the golf course immediately upstream.

Site Number WQ-17

Stream: Falling Creek

Site: 20 meters Downstream of the Old Buckingham Road Crossing,
Midlothian, Virginia

Latitude: 37° 30' 28.50134"

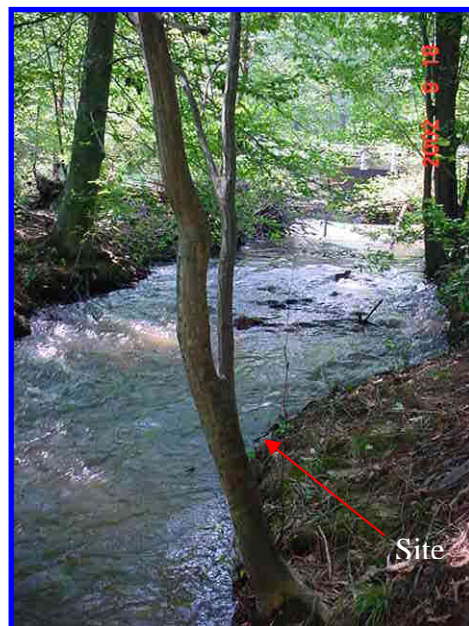
Longitude: 77° 38' 00.65209"

Watershed: Falling Creek

Stream Order: 2

Landuse: Suburban Residential

Gradient: High

Field and Laboratory Observations:

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	9.7	6.5	255	163.1	6.9	30	40	0.09	0.17	0.06	0.06	76.9
02/12/02	11.2	6.2	189	120.6	6.3	<10	45	<0.03	0.08	0.06	0.17	84.6
03/06/02	10.9	6.1	158	100.7	8.9	20	30	<0.03	0.03	0.03	0.13	92.3
04/08/02	10.4	6.4	154	98.5	9.1	25	<10	<0.03	0.06	0.06	0.05	92.3
05/15/02	9.0	6.4	110	70.5	17.4	15	15	0.07	0.22	<0.01	0.25	76.9
06/25/02	1.7	5.1	97	61.6	21.5	15	15	<0.03	0.10	<0.01	0.00	76.9
07/16/02	6.2	5.9	143	91.0	23.1	30	20	<0.03	0.13	0.04	0.10	76.9
08/20/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/18/02	7.1	6.1	88	56.2	24.8	25	<10	<0.03	0.03	<0.01	0.49	100.0
10/15/02	8.4	6.3	149	95.9	13.4	30	20	<0.03	0.09	<0.01	0.11	100.0
11/20/02	10.6	6.1	113	72.5	10.7	25	15	0.19	0.33	<0.01	0.67	76.9
12/10/02	12.2	6.2	215	137.9	3.8	25	35	0.04	0.37	<0.01	0.24	92.3
Minimum	1.7	5.1	88	56.2	3.8	<10	<10	<0.03	0.03	<0.01	0.00	0.0
Median	9.7	6.2	149	95.9	10.7	25	20	<0.03	0.10	<0.01	0.13	80.8
Maximum	12.2	6.5	255	163.1	24.8	30	45	0.19	0.37	0.06	0.67	100.0

Falling Creek is a perennial tributary of the James River and is considered one of its major watersheds. This site near the headwaters of Falling Creek in the High River Terrace region of Chesterfield County is located approximately 14.3 miles upstream of the Falling Creek site WQ-08. Here Falling Creek exhibited sustained flows throughout the year and went dry for a brief period during August 2002. Its substrate is comprised of sand, gravel and cobble. The waters at this site were largely turbid or stained, with five instances of clear water observed during the year. There was one instance of milky water noted in April. The stream's banks are slightly vegetated with moderate to heavy erosion present.

Riparian vegetation consisted primarily of trees and shrubs. Iron Bacteria, periphyton and algae were observed throughout the year. Macroinvertebrates were also noted prior to the stream going dry.

Samples were obtained from the right bank at a median depth of 0.05 meters. The annual median index score indicated fair chemical water quality, with the drought experienced by Falling Creek in August a likely influence. The majority of the physical parameters were within normal expected ranges during 2002 with a few exceptions. Dissolved oxygen concentrations during June and pH values during June and July failed to meet state water quality standards. The stream's water was soft and generally well buffered. Annual median concentrations of ammonia nitrogen and phosphate phosphorus were within expected limits. Annual median nitrate nitrogen was slightly elevated (0.10 mg/L N) but not exceedingly high. Potential sources of nitrate inputs to the headwaters of Falling Creek may be the residential areas immediately upstream of the site.

Site Number WQ-18

Stream: Falling Creek

Site: 20 meters Upstream of the Lucks
Lane Crossing, Midlothian, Virginia

Latitude: 37° 28' 14.46888"

Longitude: 77° 37' 46.21741"

Watershed: Falling Creek

Stream Order: 3

Landuse: Low Density Residential

Gradient: High

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	11.8	6.5	251	160.2	6.1	40	40	0.03	0.23	0.09	0.25	84.6
02/12/02	11.4	6.5	205	131.0	6.3	15	50	<0.03	0.15	0.14	0.14	76.9
03/06/02	11.8	6.3	169	107.9	7.3	15	35	<0.03	0.06	0.03	0.37	84.6
04/08/02	12.1	6.4	161	102.8	13.4	20	15	<0.03	0.10	0.01	n/a	100.0
05/15/02	7.9	6.5	126	80.7	17.9	25	15	0.05	0.23	0.02	0.18	76.9
06/25/02	2.8	5.9	151	96.9	24.1	35	25	0.07	0.24	<0.01	0.25	69.2
07/16/02	4.4	6.0	154	98.3	24.0	25	20	0.08	0.39	0.03	0.05	76.9
08/20/02	3.5	6.1	233	149.0	24.8	45	35	<0.03	0.15	<0.01	0.00	84.6
09/18/02	6.7	6.1	119	76.4	21.9	25	15	<0.03	0.08	<0.01	0.09	100.0
10/15/02	7.8	6.2	161	103.0	14.4	25	30	<0.03	0.17	<0.01	0.23	92.3
11/20/02	11.1	6.1	146	93.5	9.4	25	20	<0.03	0.50	0.01	0.34	92.3
12/10/02	12.8	6.2	236	151.1	3.4	25	35	<0.03	0.33	<0.01	0.51	92.3
Minimum	2.8	5.9	119	76.4	3.4	15	15	<0.03	0.06	<0.01	0.00	69.2
Median	9.5	6.2	161	102.9	13.9	25	28	<0.03	0.20	0.01	0.23	84.6
Maximum	12.8	6.5	251	160.2	24.8	45	50	0.08	0.50	0.14	0.51	100.0

Falling Creek is a perennial tributary of the James River and is considered one of its major watersheds. This site is downstream of the headwaters of Falling Creek in the Piedmont and Alluvium region of Chesterfield County and is located approximately 11.6 miles upstream of the Falling Creek site WQ-08. Flows at this site were constant over a substrate comprised of sand, gravel, cobble and boulders. The waters at this site were consistently clear with no observations of turbid or stained conditions. The stream's banks are well vegetated with slight to moderate areas of erosion present.

Riparian vegetation consisted primarily of trees, shrubs and grasses. A variety of flora was observed during the year including bacterial sheens, periphyton, algae as well as submergent and emergent plant species. Macroinvertebrates and amphibians were abundant.

Samples were obtained from the right bank at a median depth of 0.05 meters. The annual median index score indicated good chemical water quality. The majority of the physical parameters were within normal expected ranges during 2002 with a few exceptions. Dissolved oxygen concentrations during June and August, and pH values during June failed to meet state water quality standards. The stream's water was soft and generally well buffered. Annual median concentrations of ammonia nitrogen and phosphate phosphorus were within expected limits. Annual median nitrate nitrogen was elevated (0.20 mg/L N), twice the level observed at site WQ-17 approximately 2.7 miles upstream. This observation may be attributed to the increase nitrate levels observed at the headwaters of Falling Creek plus the influences of Walton Lake immediately upstream of the site.

Site Number WQ-19

Stream: Nuttree Branch

Site: 20 meters Upstream of the Old
Hundred Road Crossing, Midlothian,
Virginia

Latitude: 37° 26' 01.76377"

Longitude: 77° 38' 35.88637"

Watershed: Swift Creek

Stream Order: 2

Landuse: Suburban Residential; Golf
Course

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	10.9	6.2	129	82.5	6.0	30	20	0.03	0.22	0.11	0.12	84.6
02/12/02	11.3	6.2	152	96.5	7.2	15	25	<0.03	0.10	0.05	0.22	84.6
03/06/02	11.2	5.9	160	100.2	10.4	25	20	<0.03	0.03	0.15	0.06	84.6
03/28/02	9.3	6.0	105	67.2	11.3	60	<10	0.10	0.10	0.05	0.13	84.6
05/15/02	7.7	6.6	101	64.9	22.1	45	15	0.11	0.13	0.08	0.12	76.9
06/25/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
07/16/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
08/20/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/18/02	5.9	6.1	98	63.2	23.3	30	15	<0.03	0.04	<0.01	0.11	100.0
10/15/02	6.6	6.3	106	67.9	15.4	30	15	<0.03	0.11	<0.01	0.13	92.3
11/20/02	9.9	6.1	99	63.2	9.9	45	10	<0.03	0.14	0.05	0.18	84.6
12/10/02	11.9	6.4	153	98.0	4.4	30	15	<0.03	0.12	<0.01	0.05	92.3
Minimum	5.9	5.9	98	63.2	4.4	15	<10	<0.03	0.03	<0.01	0.05	0.0
Median	9.9	6.2	106	67.9	10.4	30	15	<0.03	0.11	0.05	0.12	84.6
Maximum	11.9	6.6	160	100.2	23.3	60	25	0.11	0.22	0.15	0.22	100.0

Nuttree Branch is a perennial tributary of Swift Creek located in the Triassic Basin region of Chesterfield County. Its substrate is comprised mainly of sand, gravel and cobble. Flows at Nuttree Branch were low throughout most of the year. During the summer, Nuttree Branch was dry for three months and had the longest period of dry conditions among all the sites monitored. When flow was present, the waters at this site were largely turbid or stained with four instances of clear water observed during the year. The banks of Nuttree Branch are well vegetated with only slight areas of erosion present.

Riparian vegetation at the site consisted primarily of trees, shrubs and grasses. Periphyton and algae were observed throughout the year. Macroinvertebrates were present in the spring.

Samples were obtained from the right bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. The majority of the physical parameters were within normal expected ranges during 2002 with one exception (March pH failed to meet state water quality standards). The stream's water was very soft and generally well buffered. The annual median concentration of ammonia nitrogen was within expected limits. The annual median nitrate nitrogen (0.11 mg/L N) and phosphate phosphorus (0.05 mg/L P) concentrations were slightly elevated. The observed increases may be due in part to the largely developed watershed and the presence of the golf course immediately upstream.

Site Number WQ-20

Stream: Swift Creek

Site: 10 meters Upstream of the Bailey
Bridge Road Crossing, Midlothian,
Virginia

Latitude: 37° 24' 40.61230"

Longitude: 77° 37' 05.21801"

Watershed: Swift Creek

Stream Order: 4

Landuse: Residential; Route 288 Parallel
to Creek; Sewage Pump Station
Immediately Downstream

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	9.9	6.6	215	137.4	5.8	50	20	0.04	0.43	0.12	0.00	84.6
02/12/02	6.2	6.4	215	138.0	6.5	80	25	<0.03	<0.02	0.19	0.00	84.6
03/06/02	10.9	6.6	146	93.7	9.3	45	25	<0.03	0.03	0.08	0.00	92.3
03/26/02	9.0	6.7	136	85.0	13.0	45	25	0.04	0.19	0.02	0.00	84.6
05/15/02	6.2	6.5	126	80.8	17.7	70	10	0.17	0.36	0.08	0.00	69.2
06/25/02	2.6	6.2	154	98.0	24.4	45	20	0.14	0.11	0.04	0.00	69.2
07/16/02	2.4	6.3	156	99.8	23.5	55	20	0.15	0.14	0.07	0.00	69.2
08/20/02	1.9	6.2	211	134.9	25.2	105	25	0.07	0.03	0.05	0.00	76.9
09/18/02	3.5	6.3	223	142.5	22.1	55	35	0.05	0.95	0.02	0.00	61.5
10/15/02	4.4	6.4	177	113.4	15.0	50	35	0.03	0.24	<0.01	0.00	92.3
11/20/02	8.3	6.2	138	88.5	8.8	65	20	0.03	0.11	0.08	0.03	84.6
12/10/02	11.1	6.3	320	204.8	3.0	55	40	0.03	0.38	<0.01	0.00	92.3
Minimum	1.9	6.2	126	80.8	3.0	45	10	<0.03	<0.02	<0.01	0.00	61.5
Median	6.2	6.4	167	106.6	14.0	55	25	0.04	0.17	0.06	0.00	84.6
Maximum	11.1	6.7	320	204.8	25.2	105	40	0.17	0.95	0.19	0.03	92.3

Swift Creek is a perennial tributary and major watershed of the Appomattox River that bisects the Piedmont and Alluvium region of Chesterfield County. This site is located approximately 13.5 miles upstream of the Swift Creek site WQ-03 and 1.6 miles downstream of the Swift Creek Reservoir. Its substrate is comprised primarily of silt and clay with scattered deposits of sand. The flows at this site were largely hydrostatic due to a significant beaver dam 300 meters downstream. During the monthly surveys, clear water conditions were rare (2 observations) with turbid or stained waters dominating. The stream's banks are well vegetated with slight to moderate areas of erosion present.

Riparian vegetation was comprised of shrubs, grasses and herbaceous growth with scattered hardwood trees. Bacterial sheens, periphyton, algae, submergent and emergent plants were prevalent throughout the year.

Samples were obtained from the left bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were all within normal expected ranges during 2002 except for summer dissolved oxygen levels which were below the state water quality threshold. The stream's water was soft and very well buffered. The annual median concentration of ammonia nitrogen was within expected limits. Annual median nitrate nitrogen and phosphate phosphorus concentrations were elevated but not atypical for a stream with such a large watershed and multiple contributing sources of nutrients.

Site Number WQ-21

Stream: Spring Run

Site: 25 meters Downstream of the Buck
Rub Drive Crossing, Midlothian, Virginia

Latitude: 37° 24' 10.85264"

Longitude: 77° 38' 52.14516"

Watershed: Swift Creek

Stream Order: 2

Landuse: Suburban Residential

Gradient: Low

**Field and Laboratory Observations:***View is downstream of bridge*

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	12.7	7.0	151	95.8	6.9	30	20	<0.03	0.07	0.09	0.15	92.3
02/12/02	12.4	6.8	133	85.6	6.5	40	20	<0.03	0.04	0.06	0.12	92.3
03/07/02	13.0	6.5	128	82.0	9.3	40	20	<0.03	<0.02	0.08	0.10	92.3
03/28/02	10.3	6.7	110	70.2	11.9	55	10	0.04	0.14	0.08	0.21	84.6
05/15/02	8.6	6.8	121	77.4	15.4	50	15	0.05	0.20	0.06	0.21	76.9
06/25/02	6.6	6.4	153	97.4	24.1	55	30	0.03	0.23	0.06	0.11	84.6
07/16/02	7.0	6.6	148	95.1	22.5	55	30	<0.03	0.16	0.13	0.14	84.6
08/20/02	1.8	6.2	196	126.0	24.4	100	40	0.63	<0.02	0.23	0.00	53.8
09/18/02	7.3	6.6	152	97.5	20.3	50	30	<0.03	0.15	0.06	0.29	84.6
10/15/02	8.5	6.8	170	108.5	13.5	55	30	<0.03	0.18	0.07	0.15	84.6
11/20/02	10.8	6.4	129	82.6	9.4	50	20	<0.03	0.14	0.06	0.16	84.6
12/10/02	12.0	6.5	210	134.8	3.6	45	30	<0.03	0.25	0.01	0.28	92.3
Minimum	1.8	6.2	110	70.2	3.6	30	10	<0.03	<0.02	0.01	0.00	53.8
Median	9.4	6.6	150	95.5	12.7	50	25	<0.03	0.15	0.07	0.15	84.6
Maximum	13.0	7.0	210	134.8	24.4	100	40	0.63	0.25	0.23	0.29	92.3

Spring Run is a perennial tributary of Swift Creek located in the Piedmont and Alluvium region of Chesterfield County. Its substrate is comprised of sand and gravel. Spring Run exhibited flow throughout much of the year, with hydrostatic conditions present only during August. There was only one instance of turbid water noted (April) with all other observations recorded as clear. The stream's banks are vegetated with slight to moderate areas of erosion present.

Riparian vegetation was dominated by hardwood trees and shrubs, with grasses and herbaceous growth present during May and June. Instream flora included bacterial sheens, periphyton, algae, and emergent plants. Macroinvertebrates and fish were also observed at times during the year.

Samples were obtained from the left bank at a median depth of 0.04 meters. The annual median index score indicated good chemical water quality. Physical parameters were all within normal expected ranges during 2002 except for August's dissolved oxygen level that was below the state water quality threshold. The stream's water was soft and very well buffered. The annual median concentration of ammonia nitrogen was within expected limits. Annual median nitrate nitrogen (0.15 mg/L N) and phosphate phosphorus (0.07 mg/L P) concentrations were elevated, most likely attributed to the dense residential development within Spring Run's watershed.

Site Number WQ-22

Stream: Third Branch

Site: 5 meters Downstream of the Spring
Run Road Bridge Crossing, Chesterfield,
Virginia

Latitude: 37° 22' 18.12083"

Longitude: 77° 35' 57.07284"

Watershed: Swift Creek

Stream Order: 3

Landuse: Rural Residential; Forested;
Site Located in Pocohontas State Park

Gradient: High

*View is downstream of bridge***Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	12.7	6.5	65	41.5	4.5	30	10	<0.03	0.03	0.07	0.04	92.3
02/12/02	12.3	6.2	66	42.3	3.6	15	10	<0.03	0.04	0.08	0.05	84.6
03/07/02	12.8	6.5	67	42.9	6.6	10	<10	<0.03	0.02	0.04	0.05	84.6
03/25/02	11.0	6.0	65	41.4	8.8	15	10	<0.03	0.04	0.06	n/a	84.6
05/15/02	9.3	6.4	63	40.4	14.2	40	<10	0.03	0.08	0.03	0.08	92.3
06/25/02	3.8	5.8	143	91.6	21.7	45	20	0.05	0.50	0.04	0.00	61.5
07/16/02	2.6	6.0	156	99.9	21.8	55	15	<0.03	0.22	0.13	0.00	76.9
08/20/02	2.7	5.9	183	116.4	24.3	105	20	0.04	<0.02	0.08	0.00	76.9
09/18/02	3.0	5.8	140	89.6	18.8	50	20	0.07	0.11	0.13	0.00	61.5
10/15/02	8.3	6.1	95	60.9	13.1	<10	15	<0.03	0.08	0.02	0.15	84.6
11/20/02	11.2	5.7	69	44.3	7.5	15	<10	<0.03	0.23	0.02	0.11	69.2
12/10/02	13.4	6.0	69	43.7	1.8	15	<10	<0.03	0.04	0.01	0.06	92.3
Minimum	2.6	5.7	63	40.4	1.8	<10	<10	<0.03	<0.02	0.01	0.00	61.5
Median	10.2	6.0	69	44.0	10.9	23	10	<0.03	0.06	0.05	0.05	84.6
Maximum	13.4	6.5	183	116.4	24.3	105	20	0.07	0.50	0.13	0.15	92.3

Third Branch is a perennial tributary of Swift Creek located in the Piedmont and Alluvium region of Chesterfield County. Its substrate is comprised largely of cobble and boulder with intermixed areas of sand and gravel. Flow diminished during the summer months until only standing water was present within the channel. The stream never went completely dry during 2002. Clear water dominated with turbid and stained conditions observed on five occasions during late spring and early winter. The stream's banks are well vegetated with slight to moderate areas of erosion present.

Riparian vegetation was dominated by hardwood trees and shrubs, with grasses present during the August through November. Instream flora included bacterial sheens, periphyton, algae, and emergent and submergent plants. Macroinvertebrates, fish and amphibians were also observed at times during the year.

Samples were obtained from the left bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were mostly within normal expected ranges during 2002; however, there were several instances in which dissolved oxygen concentrations and pH values failed to meet the state water quality standard. The stream's water was extremely soft and adequately buffered. Annual median concentrations of ammonia and nitrate nitrogen were within expected limits. The annual median phosphate phosphorus concentration (0.05 mg/L P) was slightly elevated for such a forested site but was not exceedingly high.

Site Number WQ-23

Stream: Mann Branch

Site: 5 meters Upstream of the Bundle
Road Bridge Crossing, Chesterfield,
Virginia

Latitude: 37° 20' 02.01692"

Longitude: 77° 36' 11.62718"

Watershed: Swift Creek

Stream Order: 2

Landuse: Rural Residential; Forested;
Wetland Immediately Upstream

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	12.6	6.6	61	39.2	5.0	35	10	<0.03	<0.02	0.20	0.26	84.6
02/12/02	12.0	6.3	67	42.9	4.8	10	15	<0.03	0.03	0.07	0.29	84.6
03/07/02	12.9	6.4	66	42.3	7.7	10	<10	<0.03	<0.02	0.18	0.18	76.9
03/28/02	9.2	6.0	64	40.9	14.0	10	<10	<0.03	0.02	0.08	0.52	84.6
05/15/02	7.2	6.1	66	42.7	15.5	50	<10	0.11	0.03	0.08	0.18	84.6
06/25/02	3.6	6.1	82	52.7	23.0	30	10	0.11	0.09	0.18	0.00	69.2
07/16/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
08/20/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/18/02	4.8	5.7	84	53.8	19.5	40	<10	<0.03	0.03	0.12	0.00	84.6
10/15/02	6.9	6.0	85	54.1	14.0	20	<10	<0.03	0.19	0.06	Low	84.6
11/20/02	9.9	5.5	75	48.0	7.1	25	<10	<0.03	0.18	0.03	0.18	76.9
12/10/02	11.9	5.6	67	42.6	2.3	25	15	<0.03	0.08	<0.01	0.29	92.3
Minimum	3.6	5.5	61	39.2	2.3	10	<10	<0.03	<0.02	<0.01	0.00	0.0
Median	9.6	6.0	67	42.8	10.9	25	<10	<0.03	0.03	0.08	0.18	84.6
Maximum	12.9	6.6	85	54.1	23.0	50	15	0.11	0.19	0.20	0.52	92.3

Mann Branch is a perennial tributary of Swift Creek located in the Shallow Coastal Plain and Piedmont region of Chesterfield County. Its substrate is largely comprised of sand, gravel and cobble. Flows were slow throughout the year and the stream went completely dry during July and August. Clear water and stained conditions were equally observed during 2002. The stream's banks are well vegetated with no areas of erosion present.

Riparian vegetation was dominated by shrubs, grasses and herbaceous growth. Small hardwood trees were also present in limited densities immediately adjacent to the banks. Instream flora included bacterial sheens, periphyton, algae, and emergent and submergent plants. Macroinvertebrates and fish were also observed at times during the year.

Samples were obtained from the left bank and from the bridge at a median depth of 0.05 meters. The annual median index score indicated good chemical water quality. Physical parameters were, for the most part, within normal expected ranges during 2002. Dissolved oxygen concentrations were low prior to the stream becoming dry. Upon resumption of flow, pH values were somewhat depressed reflecting the processing of accumulated plant litter during the dry spell and autumnal leaf fall. The stream's water was extremely soft and adequately buffered. Annual median concentrations of ammonia and nitrate nitrogen were both within expected limits. The annual median phosphate phosphorus concentration (0.08 mg/L P) was elevated for a rural site, especially one with such an extensive wetland upstream.

Site Number WQ-24

Stream: Cattle Creek

Site: 15 meters Upstream of the Ivey
Mill Road Crossing, Chesterfield,
Virginia

Latitude: 37° 17' 09.93978"

Longitude: 77° 37' 11.00699"

Watershed: Appomattox River

Stream Order: 2

Landuse: Rural Residential; Forested

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	12.5	6.6	62	39.5	3.6	20	15	<0.03	0.04	0.14	0.35	92.3
02/12/02	11.4	6.4	63	40.0	4.6	10	<10	<0.03	0.02	0.13	0.26	84.6
03/07/02	11.3	6.7	62	39.9	7.2	20	10	<0.03	0.02	0.16	0.44	92.3
04/22/02	8.1	6.6	72	45.7	17.3	35	<10	<0.03	0.02	0.15	0.25	92.3
05/15/02	8.4	6.5	67	43.0	16.6	40	10	0.07	0.03	0.04	0.23	84.6
06/25/02	3.8	5.9	131	83.9	22.5	90	15	1.36	0.06	0.30	0.09	46.2
07/16/02	4.4	6.3	142	90.4	22.5	105	15	1.38	0.41	0.30	0.01	53.8
08/20/02	-	-	-	-	-	-	-	-	-	-	Dry	0.0
09/18/02	6.7	5.6	115	73.9	19.3	20	10	0.10	0.07	0.08	0.25	76.9
10/15/02	8.1	5.9	114	73.0	13.8	<10	15	0.03	0.06	0.03	0.06	76.9
11/20/02	10.9	5.6	62	40.0	7.9	15	10	<0.03	0.08	<0.01	0.43	84.6
12/10/02	11.9	5.8	56	35.7	2.9	15	<10	<0.03	0.06	<0.01	0.36	84.6
Minimum	3.8	5.6	56	35.7	2.9	<10	<10	<0.03	0.02	<0.01	0.01	0.0
Median	8.4	6.3	67	43.0	13.8	20	10	<0.03	0.06	0.13	0.25	84.6
Maximum	12.5	6.7	142	90.4	22.5	105	15	1.38	0.41	0.30	0.44	92.3

Cattle Creek is a perennial tributary of the Appomattox River located in the Piedmont region of Chesterfield County. The stream's substrate is comprised of sand and gravel. Cattle Creek exhibited strong flows throughout the most of the year only going completely dry during August. There were only four instances of stained water with the remainder of the observations recorded as clear. The stream's banks are well vegetated with only slight areas of scattered erosion present.

Riparian vegetation was dominated by hardwood trees and shrubs with grasses and herbaceous growth present during the warmer months. There was an abundance of biota at Cattle Creek. Instream flora included bacterial sheens, iron bacteria, periphyton, algae, and emergent plants. Macroinvertebrates and amphibians were also prevalent during the year. Cattle Creek was the only stream monitored which had a large population of freshwater mussels present.

Samples were obtained from the left bank at a median depth of 0.05 meters. The annual median index score indicated good chemical water quality. Physical parameters were within normal expected ranges during 2002 with a few exceptions. Dissolved oxygen concentrations were low in June and pH values were slightly depressed during the latter half of the year. The stream's water was extremely soft and adequately buffered. Annual median concentrations of ammonia and nitrate nitrogen were within expected limits. The annual median phosphate phosphorus concentration (0.13 mg/L P) was high, perhaps influenced by several old ponds immediately upstream.

Site Number WQ-25

Stream: Winterpock Creek

Site: At the Winterpock Road Bridge
Crossing, Winterpock, Virginia

Latitude: 37° 20' 44.70740"

Longitude: 77° 43' 12.04342"

Watershed: Appomattox River

Stream Order: 2

Landuse: Rural Residential; Forested

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	5.6	5.9	108	68.6	4.2	25	15	<0.03	0.13	0.26	0.00	69.2
02/12/02	8.7	5.8	121	77.5	4.5	30	20	<0.03	<0.02	0.10	0.00	84.6
03/07/02	8.9	5.9	116	74.0	5.6	25	15	<0.03	<0.02	0.06	0.00	84.6
04/22/02	5.8	6.0	80	51.2	16.4	60	10	<0.03	0.03	0.07	0.23	92.3
05/15/02	3.3	6.0	83	53.3	15.7	45	10	0.11	0.02	<0.01	0.00	84.6
06/25/02	1.1	6.0	147	94.7	21.9	80	20	0.92	0.05	0.04	0.00	61.5
07/16/02	1.7	6.2	141	90.0	22.2	115	<10	0.82	0.04	0.03	0.00	61.5
08/20/02	0.8	5.6	131	83.4	23.8	55	15	0.43	0.02	0.02	0.00	53.8
09/18/02	0.7	5.9	123	78.9	19.3	45	<10	0.64	0.06	0.03	0.00	53.8
10/15/02	1.6	6.1	128	81.9	14.0	45	<10	0.59	0.02	0.01	0.00	69.2
11/20/02	8.3	5.2	78	50.2	7.5	25	10	<0.03	0.20	<0.01	0.08	84.6
12/10/02	8.3	5.2	92	59.0	2.0	30	15	<0.03	0.04	<0.01	0.00	92.3
Minimum	0.7	5.2	78	50.2	2.0	25	<10	<0.03	<0.02	<0.01	0.00	53.8
Median	4.4	5.9	118	75.8	14.8	45	13	0.06	0.04	0.03	0.00	76.9
Maximum	8.9	6.2	147	94.7	23.8	115	20	0.92	0.20	0.26	0.23	92.3

Winterpock Creek is a perennial tributary of the Appomattox River located in the Triassic Basin region of Chesterfield County. The stream's substrate is comprised of silt and clay. While Winterpock Creek never went dry, the flows were largely non-existent during the year due to beaver activity downstream. Stained water was observed at all months during the year. The stream's banks are well vegetated with only slight areas of erosion present.

Riparian vegetation was dominated by hardwood trees and shrubs with grasses and herbaceous growth present during the warmer months. Instream biota consisted largely of bacterial sheens, periphyton and algae.

Samples were obtained from the left bank and the bridge at a median depth of 0.10 meters. The annual median index score indicated fair chemical water quality. Physical parameters were mostly within normal expected ranges during 2002. Dissolved oxygen concentrations failed to meet state water quality standards from May through October and low pH values were observed at several month during the year. The lack of flow at this site combined with the warm summer temperatures and noticeably increased density of bacterial sheens may all contribute to the lack of oxygen at this site. The low pH observed in Winterpock Creek is possibly the natural condition for this stream. Winterpock Creek's water was extremely soft and well buffered. The annual median concentration of ammonia nitrogen was high (0.06 mg/L N) and may be related to the increased bacterial activity. The annual median concentration of nitrate nitrogen was within its expected limit. The annual median phosphate phosphorus concentration (0.03 mg/L P) was slightly elevated but was not exceedingly high.

Site Number WQ-26

Stream: Appomattox River

Site: 25 meters Upstream of the River
Road Bridge Crossing, Winterpock,
Virginia

Latitude: 37° 19' 07.23503"

Longitude: 77° 48' 07.97536"

Watershed: Appomattox River

Stream Order: 5

Landuse: Forested

Gradient: Low

**Field and Laboratory Observations:**

Date	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Index Score % Comparison
01/15/02	12.6	6.4	100	64.0	2.9	30	15	<0.03	0.31	0.10	1.04	84.6
02/12/02	12.1	6.6	102	65.2	4.5	45	20	<0.03	0.26	0.11	0.74	84.6
03/07/02	12.2	6.6	105	67.4	5.8	35	20	<0.03	0.25	0.13	1.18	84.6
04/22/02	7.2	6.9	109	69.7	17.7	45	15	0.04	0.22	0.06	1.24	84.6
05/15/02	8.9	6.9	105	67.1	17.4	45	15	<0.03	0.35	0.03	0.77	84.6
06/25/02	5.4	6.7	150	95.7	26.4	45	30	0.03	0.21	0.04	0.52	84.6
07/16/02	5.9	6.9	157	100.4	25.5	65	25	<0.03	0.02	0.04	0.27	92.3
08/20/02	5.3	6.7	163	104.2	26.7	80	30	<0.03	0.02	0.01	0.02	100.0
09/18/02	6.5	6.7	145	92.8	21.9	30	30	<0.03	0.04	<0.01	0.97	100.0
10/15/02	8.2	6.6	120	76.6	15.7	45	20	<0.03	0.60	0.01	0.83	84.6
11/20/02	9.8	5.8	75	48.3	8.2	60	<10	<0.03	0.13	0.05	1.03	76.9
12/10/02	13.0	6.0	97	62.6	0.9	40	20	<0.03	0.33	<0.01	0.67	92.3
Minimum	5.3	5.8	75	48.3	0.9	30	<10	<0.03	0.02	<0.01	0.02	76.9
Median	8.5	6.7	107	68.6	16.6	45	20	<0.03	0.24	0.04	0.80	84.6
Maximum	13.0	6.9	163	104.2	26.7	80	30	0.04	0.60	0.13	1.24	100.0

The Appomattox River forms the western border of Chesterfield County and is one of its major watersheds. This site is located at the County line and lies in the Low River Terrace and Alluvium region of Chesterfield County. The river's substrate is of cobble, boulders, and bedrock with interspersed areas of sand and gravel. The river exhibited good flows throughout the year. The water of the Appomattox River was stained or turbid for most of the year with clear conditions only present during June through September. The stream's banks are not well vegetated and are heavily eroded.

Riparian vegetation was dominated by hardwood trees, shrubs and grasses. Instream flora observed included bacterial sheens, periphyton, algae, submergent and emergent plants. Macroinvertebrates and fish were also noted during the year.

Samples were obtained from the right bank at a median depth of 0.10 meters. The annual median index score indicated good chemical water quality. Physical parameters were all within normal expected ranges during 2002. The Appomattox River's water was soft and well buffered. The annual median concentration of ammonia nitrogen was within expected limits. Annual median nitrate nitrogen (0.24 mg/L N) was high, more than likely due to multiple sources of nitrogen within the river's large watershed. The annual median phosphate phosphorus concentration (0.04 mg/L P) was slightly elevated as well, but was not exceedingly high.

Discussion:

A review of the annual median chemical water quality index values demonstrated that the majority of the streams that were monitored in 2002 could be characterized as streams with good or excellent water quality (figure 1). Fair water quality was observed at seven of the streams monitored (figure 1). No streams were categorized as being significantly degraded during 2002.

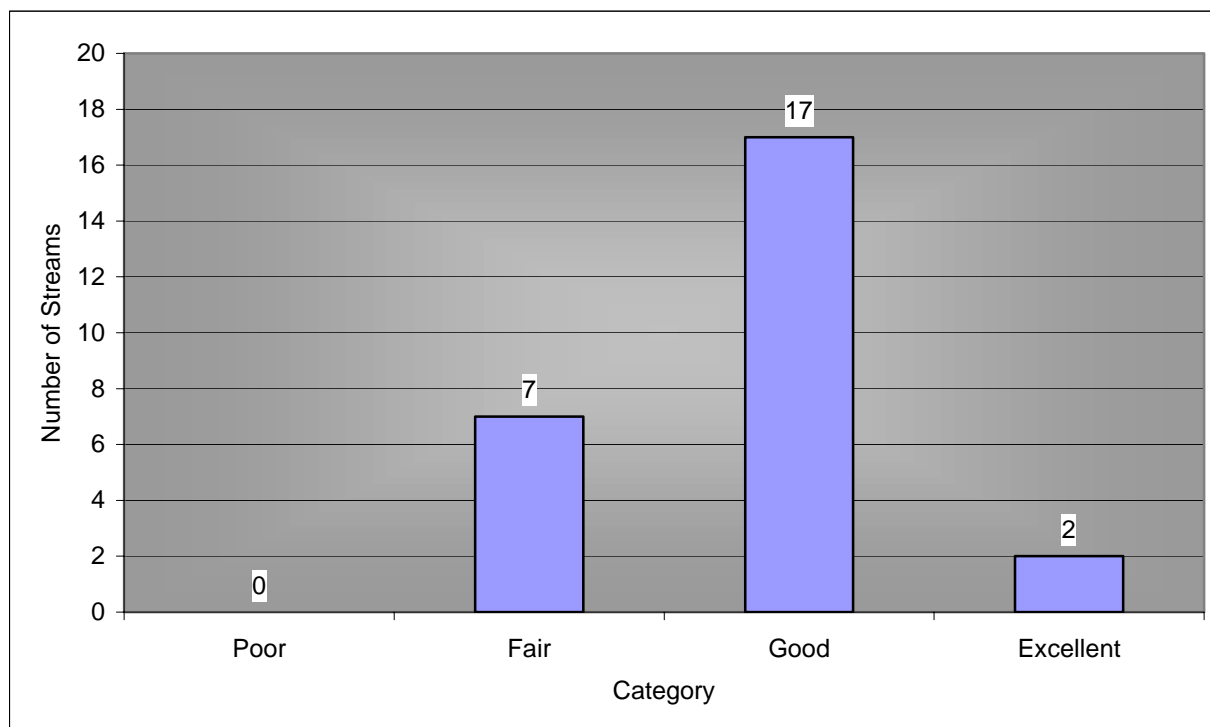


Figure 1. Annual chemical water quality categorical observations for 26 streams of Chesterfield County, 2002. Categorical determinations are based on annual median values for each stream.

Excellent water quality was observed at Swift Creek (WQ-03) and Powhite Creek (WQ-15) during 2002. Distinguishing characteristics of these streams included infrequent periods of low dissolved oxygen and pH values well within Virginia's water quality standard throughout the year. Additionally, other physical and chemical parameters were either all indicative of good water quality or were not substantially degraded on a monthly basis. It is interesting that these two sites are diametrically opposed in terms of adjacent land use yet share many similar chemical water quality characteristics. Swift Creek (WQ-03) is fairly remote compared to other sites while Powhite Creek (WQ-15) is in a heavily developed watershed.

Fair water quality was observed at several sites during 2002 with the majority of the observations (Sites WQ-02, 04, 05, 07, and 09) clustered in the southeastern portion of the county. Two additional sites (WQ-17 and WQ25) were also categorized as fair and were located in the northern and southwestern areas of the County respectively. With the exception of site WQ-25 (Winterpock Creek), all fair water quality streams flowed through relatively densely populated areas. General distinguishing characteristics of these streams included episodic periods of low dissolved oxygen and pH coupled with frequent elevated concentrations of

nitrogen and phosphorus. The remainder of the monitored sites possessed annual median index scores indicative of good water quality.

Table 2. Annual median values for water quality parameters, 2002. Bold values indicate observations that did not meet standards.

Site Number	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (microS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Alkalinity (mg/L CaCO ₃)	Calcium Hardness (mg/L CaCO ₃)	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Phosphate (mg/L as P)	Flow (m/s)	Chemical Water Quality Index Category
1	6.6	6.0	192	122.9	17.6	50	18	<0.03	0.08	0.05	0.00	Good
2	6.8	5.5	83	52.9	16.4	30	<10	<0.03	0.08	0.02	0.00	Fair
3	7.2	6.3	98	62.7	17.8	30	15	<0.03	0.11	0.01	0.06	Excellent
4	11.0	5.9	100	64.1	11.8	30	<10	<0.03	0.11	0.07	0.31	Fair
5	8.1	6.0	135	86.4	17.2	40	<10	0.06	0.14	0.02	0.22	Fair
6	7.2	5.9	96	61.8	17.2	30	<10	<0.03	0.09	0.06	0.13	Good
7	9.2	6.1	128	82.2	16.3	15	18	<0.03	0.27	0.04	0.39	Fair
8	8.9	6.5	130	83.5	19.6	25	25	0.04	0.15	0.02	0.31	Good
9	7.7	5.8	81	52.0	18.6	25	10	<0.03	0.06	0.02	0.00	Fair
10	10.0	6.0	53	34.1	14.0	25	<10	<0.03	0.04	0.06	0.15	Good
11	7.7	5.6	48	30.8	16.5	30	<10	<0.03	0.05	0.05	0.41	Good
12	8.1	6.5	113	72.5	16.2	35	15	<0.03	0.08	0.04	0.19	Good
13	6.2	6.3	143	91.7	18.5	30	20	<0.03	0.12	0.04	0.01	Good
14	10.4	6.5	132	84.6	12.7	30	20	<0.03	0.12	0.06	0.17	Good
15	7.8	6.5	140	89.7	17.4	35	20	<0.03	0.12	0.06	0.43	Excellent
16	7.1	6.2	140	89.6	16.4	40	23	<0.03	0.08	0.10	0.06	Good
17	9.7	6.2	149	95.9	10.7	25	20	<0.03	0.10	<0.01	0.13	Fair
18	9.5	6.2	161	102.9	13.9	25	28	<0.03	0.20	0.01	0.23	Good
19	9.9	6.2	106	67.9	10.4	30	15	<0.03	0.11	0.05	0.12	Good
20	6.2	6.4	167	106.6	14.0	55	25	0.04	0.17	0.06	0.00	Good
21	9.4	6.6	150	95.5	12.7	50	25	<0.03	0.15	0.07	0.15	Good
22	10.2	6.0	69	44.0	10.9	23	10	<0.03	0.06	0.05	0.05	Good
23	9.6	6.0	67	42.8	10.9	25	<10	<0.03	0.03	0.08	0.18	Good
24	8.4	6.3	67	43.0	13.8	20	10	<0.03	0.06	0.13	0.25	Good
25	4.4	5.9	118	75.8	14.8	45	13	0.06	0.04	0.03	0.00	Fair
26	8.5	6.7	107	68.6	16.6	45	20	<0.03	0.24	0.04	0.80	Good

All streams possessed annual median dissolved oxygen concentrations that met Virginia State Water Quality Standards (table 1). For individual streams, summer represented the time in which most monthly values failed to meet the good water quality threshold. This is not uncommon as summer usually is the time in which flows are the lowest or non-existent and the temperature of the water is the greatest. Since dissolved oxygen concentrations are inversely related to temperature (cold water holds more oxygen), dissolved oxygen levels are typically at their lowest during the summer months.

Seven streams had annual median pH values that were below the minimum threshold for acceptable water quality (figure 2). The lower pH observations may represent a natural condition for these streams. Many streams in Virginia are naturally acidic due to organic acids synthesized during decomposition of leaf litter and other plant matter. Continued monitoring should be able to ascertain the “normal” pH of these waters. No sites ever surpassed the maximum pH limit of 9.0 units.

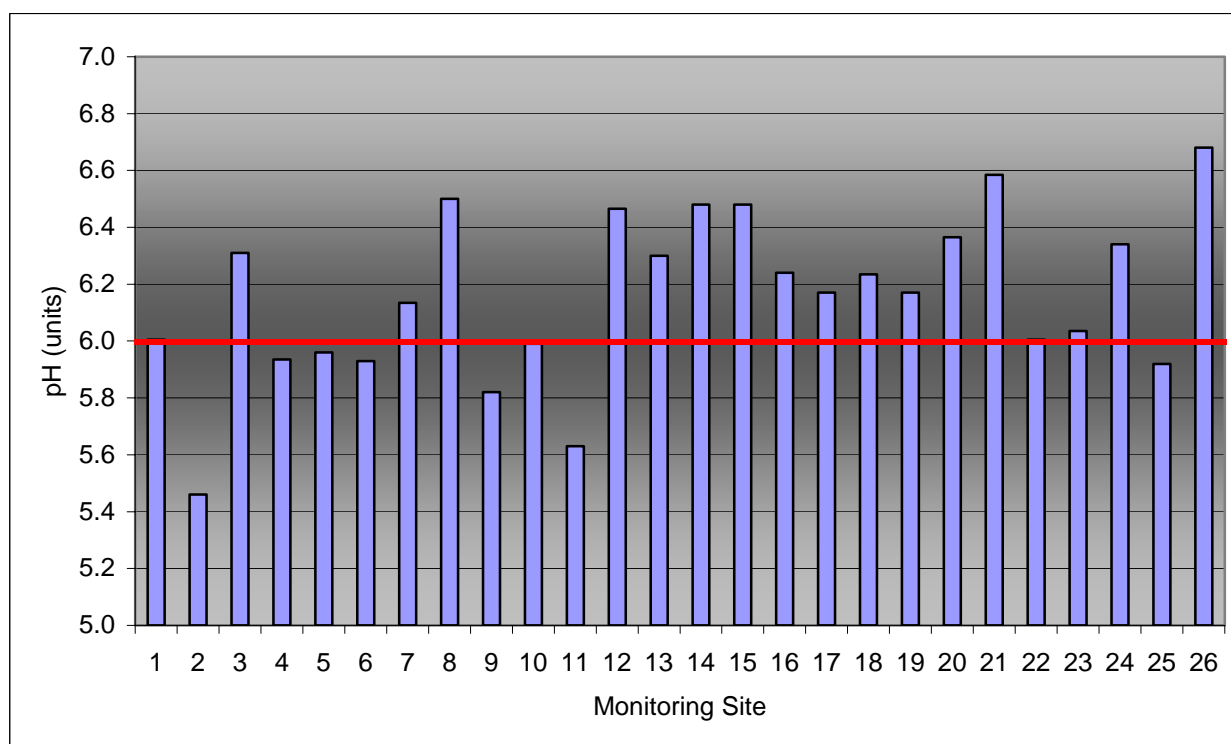


Figure 2. Annual median pH observations among 26 sites within Chesterfield County, 2002. The red bar represents Virginia Department of Environmental Quality's minimum value water quality standard.

Annual median values for conductivity and total dissolved solids were all within expected limits for 2002. During the year, the highest conductivity and total dissolved solids concentrations were observed at site WQ-01 (Johnson's Creek), a tidally influenced tributary of the Appomattox River. Additionally, the Falling Creek watershed generally had higher conductivity and total dissolved solids values greater than the other streams and drainages, perhaps due to a difference in the geology of the basin.

At all sites, temperature varied normally according to season and there were no observations that violated state water quality standards.

All monitored streams had soft water, indicating the potential for increased metals toxicity should a spill or discharge occur (table 2). The soft water is indicative of Chesterfield County's geology and is not in and of itself a reflection of poor water quality. Similarly, all streams except for one had annual median alkalinity values that characterized them as adequately or well buffered waters (>20 mg/L CaCO_3 , table 2). These streams would be able to respond to natural fluctuations in acidity without any severe impacts to aquatic life. At site WQ-07 (Kingsland Creek), the annual median alkalinity value was low (15 mg/L CaCO_3) reflecting a system that potentially could have problems should there be a drastic change in pH.

The majority of the streams monitored were not substantially impacted by ammonia nitrogen contamination. Of all the streams, Redwater Creek (WQ-05) and Winterpock Creek

(WQ-25) had the two greatest annual medians for ammonia nitrogen (0.06 mg/L N). Both streams were rated as possessing fair water quality.

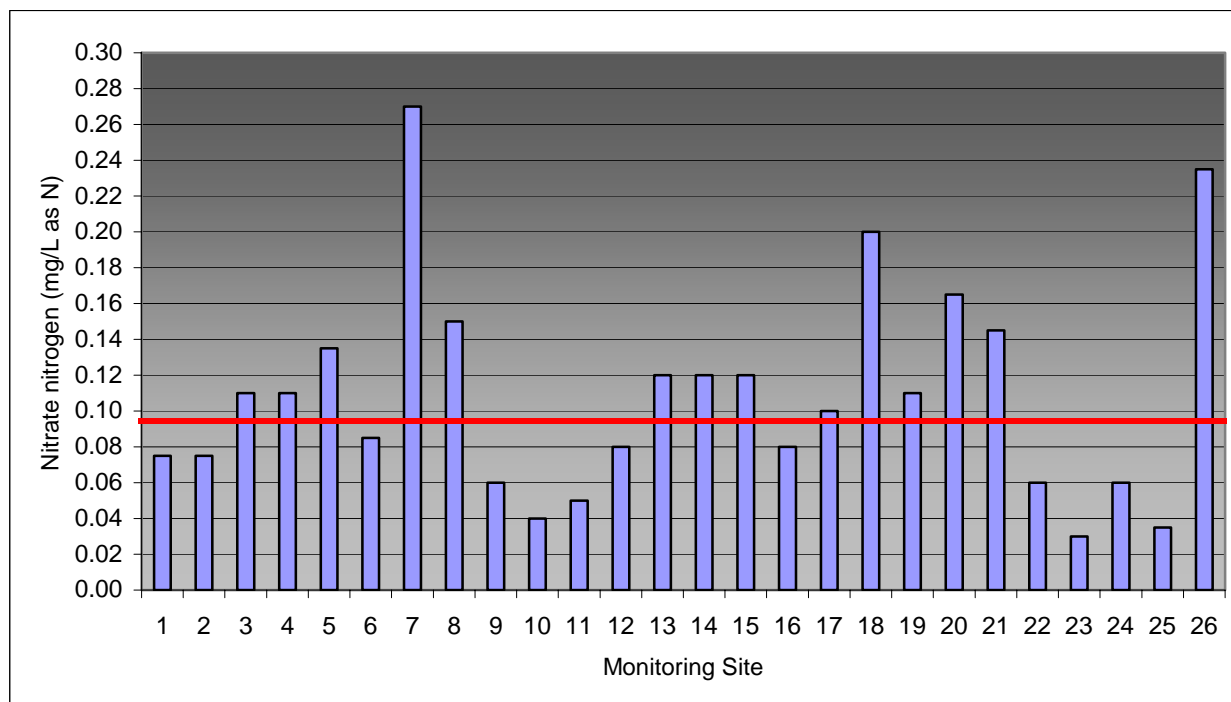


Figure 3. Annual median nitrate nitrogen observations among 26 sites within Chesterfield County, 2002. The red bar represents the USEPA's local reference condition for Level III Ecoregion 65 streams.

Fourteen streams had nitrate nitrogen concentrations that exceeded the USEPA's reference condition for the ecoregions in which Chesterfield County is located (figure 3). The greatest levels were observed at Kingsland Creek (WQ-07), Falling Creek (WQ-18) and the Appomattox River (WQ-26). Nitrate nitrogen was the second most ubiquitous pollutant in the streams of Chesterfield County.

Most all of the streams monitored during 2002 had some degree of elevated phosphate phosphorus concentrations (figure 4). Swift Creek (WQ-03) and Falling Creek WQ-17) were the only two streams that had annual median concentrations at or less than the 0.01 mg/L reference value for ideal forested systems. The greatest annual median concentrations were observed at Pocoshock Creek (WQ-16) and Cattle Creek (WQ-24). While Pocoshock Creek (WQ-16) is immediately downstream of a major golf course and may have been expected to possess higher phosphate phosphorus concentrations, Cattle Creek (WQ-24) is a very rural and forested site. The elevated levels observed at such a variety of sites with different land uses throughout the county indicate that phosphate phosphorus is the most cosmopolitan pollutant to the streams of Chesterfield County.

Flows varied from hydrostatic at several sites to 0.80 m/s at the Appomattox River (WQ-26). For all streams, August was the month in which all streams were either dry or at their

lowest point. The severe drought that was present during 2002 significantly impacted water levels at all sites in Chesterfield County and Virginia.

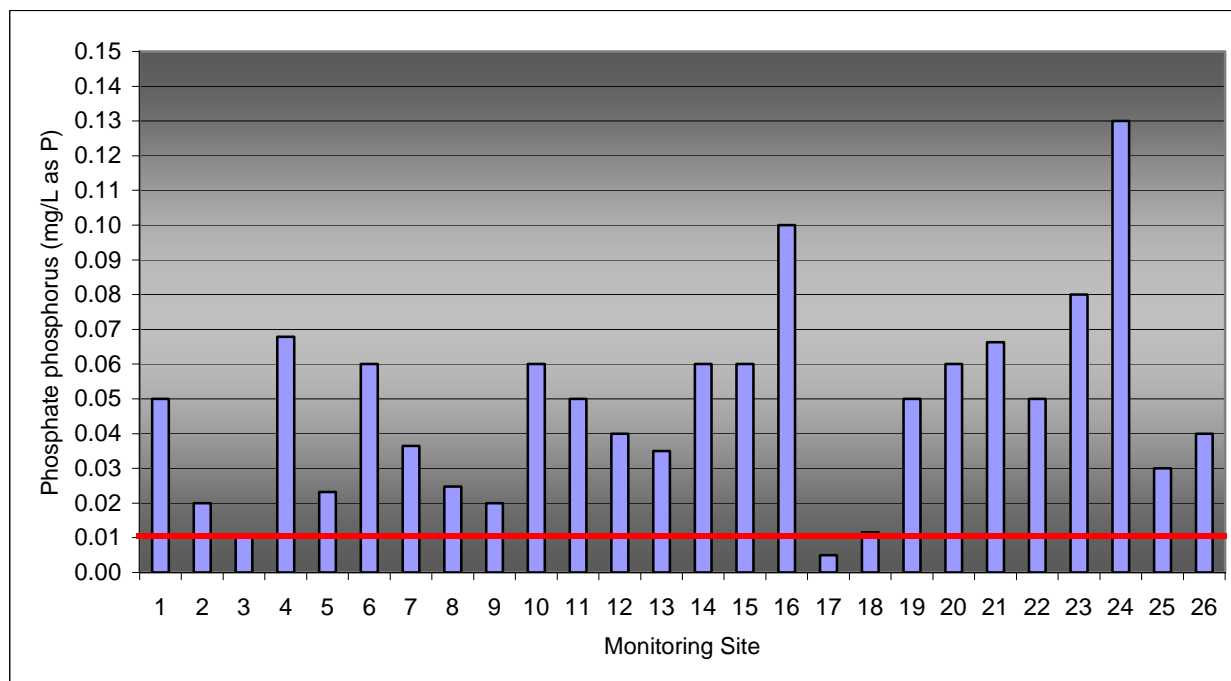


Figure 4. Annual median phosphate phosphorus observations among 26 sites within Chesterfield County, 2002. The red bar represents the Center for Watershed Protection's published values for forested systems.

Conclusions:

The overall chemical water quality within the monitored streams of Chesterfield County is good. There were no instances of substantially degraded conditions with only seven sites scoring in the "fair" category. Impacts to the streams were mostly attributed to low dissolved oxygen and pH in conjunction with high nutrient concentrations. The majority (19) of the streams investigated during 2002 possessed good or excellent chemical water quality.

Monitoring efforts will continue into 2003 with minor changes. Due to the lack of substantial monthly variation, alkalinity and calcium hardness will be determined on a quarterly basis. Additionally, turbidity and nitrite nitrogen will be added to the monthly analysis in order to better comply with the EPA's Ambient Water Quality Criteria's parameter list. All other analytes will be retained to observed trends within the monitored streams over time.

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